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di Scienze Naturali
e del Museo Civico
di Storia Naturale di Milano

Volume XXXIII – Fascicolo I

WILDLIFE AND PLANTS IN TRADITIONAL AND MODERN TIBET: CONCEPTIONS, EXPLOITATION AND CONSERVATION

Edited by
ALESSANDRO BOESI & FRANCESCA CARDI

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Wildlife and plants in traditional and modern Tibet: conceptions, exploitation and conservation

Edited by Alessandro Boesi & Francesca Cardi

Shangdril, Centro Studi per l'Himalaya e il Tibet
Società Italiana di Scienze Naturali

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In copertina: Drawing of a Tibetan medicinal plant (*spang rgyan sngon po, Gentiana* spp.) made by a Tibetan artist, Litang (Sichuan, China), 1999 (from the authors' collection).

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FOREWORD

The regions inhabited by the populations of Tibetan language and culture extend over a vast area in central Asia almost corresponding to the land mass occupied by the Tibetan plateau. The severe climate and environment of the highest mountain ranges and plateaus in the world strongly influence the life of these peoples, who have however managed to live in harmony with their habitat for more than a millennium while exploiting its resources in a sustainable way. However, since the 1950s the Tibetan society has been subject to various transformation processes: political, cultural, socio-economic, and demographic. These phenomena have changed the traditional way of life of Tibetans and have increased human pressure on the local environment, imperilling its future.

The aim of this issue of *Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* is to bring together both traditional local perspectives on the natural world and researchers' perspectives on conservation issues, wildlife and plant status, and their exploitation by local people. We believe that, to be effective, conservation actions in Tibetan cultural regions should take into account not only the status of local environment, but also the people living in it. In addition, the knowledge of traditional conceptions and exploitation systems of the natural world as well as their cultural and economic impact on the life of local people represent crucial factors to take proper decisions. Hence, this issue addresses the following themes: the traditional Tibetan knowledge related to the plant and animal world, to medicinal plants and their utilization; the traditional ways of exploiting and managing natural resources on the Tibetan plateau; the present exploitation of wildlife and plant species and its effects on the ecosystems of the high altitudes of Himalaya and Tibet; conservation measures to take.

The contributions of George Schaller, Lü Zhi, Wang Hao, and Su Tie and the one of Joseph Fox and Dawa Tsering are devoted to describing wildlife status, exploitation and conservation in the Tibetan Plateau's northwest highlands, a huge area mostly over 4,500 m of altitude known as Chang Thang, which once (and at a lesser extent today) hosted one of the most spectacular wildlife communities remaining today on the planet: tens of thousands of Tibetan antelope (*Pantholops hodgsoni*), Tibetan gazelle (*Procapra picticaudata*), Tibetan wild ass (*Equus kiang*), blue sheep (*Pseudois nayaur*), wild yak (*Bos grunniens*) and Tibetan argali (*Ovis ammon*). Owing to a dramatic decrease in wildlife populations occurred in the past few decades, in particular of the Tibetan antelope and wild yak, Chinese Government established the Chang Thang Nature Reserve, a huge area extending over 300,000 km^2 in the northwestern part of Tibetan plateau. Increased human population and livestock in marginal areas compete with wildlife for resources, in particular pastures. Some species, as Tibetan antelope, are threatened. Antelope has been recently severely hunted and its number dramatically decreased as a result of the international demand for its extremely fine wool, known as shahtoosh, which is used to manufacture luxury items: that is how fashion trends in western countries may affect the environment in distant regions.

In his contribution, Toni Huber describes the unique system of antelope hunting undertaken by indigenous hunters, which has allowed them to exploit this species in a sustainable manner for more than a millennium. Pastoralists employ several different strategies for hunting this animal: road traps, foot traps, blinds or hides, guns and food lures. The specificity and appropriateness of each of these methods, as Huber affirms, can only be appreciated from the perspective of the overall ecology and behavioural traits of the antelope, to which the deployment of hunting techniques is closely linked. Yet, this special hunting tradition has now been virtually eliminated due to strict modern conservation laws and their enforcement, as well as the severe depletion or local extinction of favoured game species in some regions.

Two contributions are devoted to analysing the plant world from the Tibetan perspective. The former, written by Alessandro Boesi, focuses on Tibetan plant conception, identification, designation, and classification systems in different regions of the Tibetan cultural area. The latter, the one of Francesca Cardi, is devoted to analysing medicinal plant exploitation in Tibetan regions. Since the beginning of Tibetan civilisation these traditions have been passed on from generation to generation orally at the popular level, while educated traditional doctors have also relied on textual sources, which describe plant qualities, gathering and exploitation systems. However, Tibetan botanical knowledge is threatened by the recent transformations of the Tibetan society and its recording should be made quickly before it is lost forever: the new generations of Tibetans have not often received from the old ones all the information on the natural world that were once necessary for them to make their living. The establishing of modern institutes of Tibetan medicine, the specialisation of practitioners, the standardisation of medical schools, and in particular of the *materia medica* and drug processing, have been changing the way of practising Tibetan medicine.

The contribution of Daniel Winkler focuses on the gathering and trade of *Cordyceps sinensis* (a parasitic fungus) in Litang and other areas of Tibet and Himalaya. Many Tibetan communities nowadays rely on that produce as an important source of income, being involved in the gathering and trading of that drug, extensively employed in Chinese medicine and/or diet as an aphrodisiac and tonic. This contribution gives evidence of the transformations occuring in Tibetan regions in the last few decades as far as the exploitation of natural produces is concerned. Following the recent economic liberalisation, development of markets linked to the international economy, improved transportation, and increased market demand for well renowned natural substances, many of which coming from the Tibetan regions, used in traditional medicines and diet, and sought after by pharmaceutical and phyto-pharmaceutical companies, the trading in natural produce gathered in the wild has been skyrocketing. These various kinds of produce, which include many plants, may be bartered or sold for the cash needed to pay taxes or to purchase staple commodities, including food in case of famine. No detaled surveys have been undertaken up to now to assess whether the exploitation of these substances has been affecting the natural environment and in particular the ecosystem stability of the highest rangelands and highlands in the world.

We would like to thank the Museo di Storia Naturale of Milan and the Società Italiana di Scienze Naturali, which kindly supported the publication of this issue.

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Toni Huber

Antelope hunting in northern Tibet: cultural adaptations to wildlife behaviour

Abstract - The Tibetan antelope (*Pantholops hodgsoni*) is the only genus of large mammal endemic to the Tibetan plateau. During the past decade, it has become widely known because its numbers are threatened by illegal hunting. This recent over-exploitation is a result of the international demand for its extremely fine wool, known as shahtoosh, which is used to manufacture luxury fashion items (Wright & Kumar, 1997). What is much less well known is that Tibetan antelope have been harvested in a sustainable manner for more than a millennium by indigenous hunters living adjacent to major antelope populations on the northern Tibetan plateau. The unique local hunting culture that has developed around the harvest of Tibetan antelope is virtually unknown outside of the region. The present contribution is an ethnographic and historical investigation into traditional Tibetan antelope hunting, and also represents the first detailed and systematic study of Tibetan hunting undertaken to date. Antelope hunting is presented from the local Tibetan perspective, with a focus upon how hunting methods attempt to capitalize on the particular ecology of *Pantholops*. The results are mainly derived from field research undertaken during 2002 and 2003 among Tibetan pastoralist communities in northern Gertse (T. *sGer-rtse*) County and some adjacent areas of the Tibet Autonomous Region, People's Republic of China.

Riassunto - La caccia all'antilope nel Tibet settentrionale: adattamenti culturali al comportamento animale.
L'antilope tibetana (*Pantholops hodgsoni*) è l'unico genere di grandi mammiferi edemico dell'altopiano tibetano. Durante gli ultimi decenni questa specie è divenuta famosa giacché minacciata dalla caccia illegale. Il recente sfruttamento eccessivo di questa specie è il risultato della domanda internazionale per la sua lana molto pregiata, conosciuta come shahtoosh e impiegata per fabbricare capi lussuosi ed alla moda (Wright & Kumar, 1997). E' invece meno noto che l'antilope tibetana è stata sfruttata in maniera sostenibile per più di un millennio dai cacciatori indigeni che vivono insieme alle più numerose popolazioni di antilopi dell'altopiano tibetano settentrionale. La peculiare tradizione locale di caccia che si è sviluppata in relazione allo sfruttamento dell'antilope è sconosciuta al di fuori di questa regione. Il presente articolo è una ricerca etnografica e storica sui sistemi tradizionali di caccia all'antilope tibetana e rappresenta il primo studio sistematico della caccia tibetana fino ad oggi intrapreso. La caccia all'antilope è presentata dal punto di vista dei tibetani, con un'attenzione particolare al modo in cui i sistemi di caccia cercano di capitalizzare sull'ecologia particolare di *Pantholops*. I risultati derivano principalmente da ricerca sul campo condotta durante il 2002 e 2003 tra le comunità di nomadi tibetani nella parte settentrionale della Contea di Gertse (T. *sGer-rtse*) ed in alcune aree vicine della Regione Autonoma Tibetana della Repubblica Popolare Cinese.

INTRODUCTION

Tibetans have been hunters for as long as there is material evidence of human habitation on the Tibetan plateau. Hunting for both subsistence and economic gain has continued in many Tibetan populated areas until very recently. However, as a domestic activity, hunting has now been virtually eliminated due to strict modern conservation laws and their enforcement, as well as the severe depletion or local extinction of favoured game species in some regions.

Hunting has been a particular, and mostly supplementary feature of various pastoralist economies across all highland steppe regions of the Tibetan plateau located north of about latitude 32° N. This is the zone where pastoralist societies have often been located in close proximity to the main ranges of the wild ungulate species that are most valued as traditional game animals (T. *ri-dwags*)[1]. The principal Tibetan animals of the chase on the high plateau include the wild yak (*Bos grunniens*; T.*'brong*), Tibetan antelope[2] (*Pantholops hodgsoni*; T. *gtsod*), Tibetan argali sheep (*Ovis ammon hodgsoni*; T. *gnyan*), blue sheep (*Pseudois nayaur*; T. *gna'-ba*), Tibetan gazelle (*Procapra picticaudata*; T. *dgo-ba*), and the Tibetan wild ass (*Equus kiang*; T. *rkyang*).

[1] Tibetan names in the main text are given in simple phonetic form. Proper Tibetan spellings, according to the Wylie (1959) system of transliteration, follow in parentheses after the first occurrence of a word, and are marked T.

[2] Tibetans universally refer to *Pantholops* as "tsö " (written as *gtsod*), however the common names used in western literature are unfortunately confusing. The designation "antelope" is a misnomer based upon the resemblance of the male animals to African antelopes. Taxinomically, *Pantholops* is a caprid, and more closely related to the ancestors of sheep and goats (Schaller, 1998: 42, chpts. 13 & 14; Schaller, 2000: 22). The frequently used word *chiru* is held to be a local Tibetan name. However, there is no written Tibetan word in any of the textual sources, which could be pronounced in this way and which is known to specifically denote the antelope. Furthermore, none of the pastoralist dialect communities living adjacent to major antelope populations currently employ such a word. I would venture that chiru is a dialect variant of the technical term "tsura" (i.e. *gtsod-rwa*), probably from Khams (an area lacking antelope). *Gtsod-rwa* refers to antelope horns traditionally attached to the barrels of Tibetan matchlocks for use as prongs upon which to rest the gun for shooting. The term has been picked up in eastern Tibet by early travellers and used in subsequent western literature. The Khalka Mongolian word *orongo* is also used in the western sources to refer to the Tibetan antelope. However, this is misleading since there are no Tibetan antelope in Mongolia, where the word *orongo* refers to smaller species of gazelles whose horns are curved backwards rather than erect.

It is a common feature of societies who regularly hunt that the principal species of game are accorded some significant role in cultural discourses and symbolism. It is of interest that in Tibetan areas, the larger and more powerful of these traditional game animals, such as the wild yak, deer, argali sheep and, to a lesser extent, wild ass, have a well established and sometimes complex role in indigenous Tibetan mythology and cultic and symbolic systems, while the smaller game species, such as antelope, blue sheep and gazelle barely feature at all. Similarly, in the vast corpus of Tibetan classical and folk literature there are numerous stories about and accounts of hunting, but the antelope and other smaller wild ungulates are virtually absent from all of these as well. Tibetan petroglyphs, which are the only prehistoric set of representations discovered in the region, mainly depict hunting themes and wild animals. From among hundreds of available examples, again we find that the antelope, with its very distinctive long and erect horns, is not obviously portrayed, while larger and symbolically more important animals such as wild yak and deer predominate.[3] The absence of the antelope in the Tibetan cultural media that portray hunting and wildlife might lead us to believe that the animal had a very low cultural status as a favoured species of game. However, other materials indicate that Tibetan antelope have been hunted since ancient times.[4]

ANCIENT ANTELOPE HUNTING

Early textual sources show that antelope were hunted during the reign of the Pugyel (T. *sPu-rgyal*) dynasty, the first historical Tibetan state, between the 7th and 9th centuries A.D. In a Chinese-Tibetan lexical list (Pelliot tibétain 2762) from the period, a series of names of animals of the chase includes the antelope (spelled *sol*; the regular spelling *gtsod* is currently pronounced "tsö") together with the Chinese *houang-yang*, which means "antelope" (Pelliot, 1961: 143-144). The common Tibetan names for the main wild ungulates are all established in the Old Tibetan documents of this era, and the antelope (spelled *gcod*) is listed as a game animal in early texts concerning the royal hunt (Pelliot tibétain 1071, 1072).[5] These mass hunts, known as ling (T. *lings*) in Old Tibetan, involved the rounding up and encirclement of game by a large hunting party, the lower ranks of whom were on foot with the higher ranks being mounted on horseback. The killing of game was done with bow and arrow, or lance and sword at close quarters, as the circle of hunters closed in. The text mentions the presence of all the highest ranks of imperial officials participating in these hunts, while other sources mention the emperors themselves engaged in the hunt (Bacot *et al.*, 1940: 18/39, 23/47, 26/52).

It is significant that the Pugyel dynasty originated from, and was established in, the larger valley systems of southern Central Tibet, with successive rulers leaving enduring traces of their reign in the area around Lhasa, further southward to Yarlung (T. *Yar-klungs*) and east across to Kongpo (T. *rKong-po*). The mention of hunting all of the presently northern ranging species of large wild ungulates, plus deer, in the ancient ling hunts could indicate several interesting conclusions: that the entire Tibetan court and their retinue migrated very great distances northward across the high plateau in order to encounter these game species and hunt them within their present range; or, that during the 7th to 9th centuries, species such as antelope, wild yak, argali and wild ass had a much greater southern extension of their range.

The Pugyel dynasty conquered large areas of western Gansu adjacent to the northeastern Qinghai-Tibetan plateau (T. *A-mdo*), and the area became a Tibetan colony with substantial occupation forces settled there. In the excavated remains of the Tibetan colonial habitations, we find further evidence of ancient antelope hunting. Wooden message slips written in Old Tibetan mention the use of antelope skins as cloaks and coats (Wang Yao, 1988: 549). Several foot traps for catching game were excavated from refuse heaps at former Tibetan military watchtowers located near Dunhuang in the Hexi region of far western Gansu.[6] These ancient traps are identical in all aspects of their design, dimensions and materials to the particular foot trap known in recent centuries in Tibet as the "khogtse".[7] This same trap, effective especially for the capture of medium to small ungulate species, is the one made and used by the antelope hunters of northern Tibet up until the present-day.

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[3] See, for example, Administration Commission of Cultural Relics of the Tibetan Autonomous Region (1994).

[4] A parallel situation exists for the Saiga (*Saiga tartarica*) among Kazakh pastoralists; the species has no symbolic importance compared to more powerful animals of chase, yet it is commonly hunted for subsistence reasons (personal communication, Ömer Akakça, Berlin, 2003).

[5] For the manuscripts see Spanien & Imaeda (1979: plates 378-413), and a modern transcription in bSod-nams-skyid & dBang-rgyal (1983: 12-51). See Wang Yao & Cheng Jian (1983: 7-35) for a Chinese interpretation, and Richardson (1990) for a partial English summary with notes.

[6] See Stein (1921, vol. II: 704, 767, 782; vol. IV: plate LIV, item no.T. XV. A. i. 009). As of 2003, one of these traps was on display at The British Museum, Oriental Antiquities Department, public display case 67, serial number: OA MAS 747 and 796.

[7] The word is current in pastoralist dialects of north-western Tibet, although the literary spelling is highly uncertain, with *kog-tsi, kog-tse, kog-tshe, kog-rtse, khog-tse, khog-rtse* and *sgog-rtse* reported as variants (acknowledgement to Dan Martin for contributing some of these).

ANTELOPE HUNTERS OF THE WESTERN CHANGTHANG

The current range of the Tibetan antelope is confined to the northern Tibetan plateau system, or Changthang (T. *Byang-thang*) as it is called in Tibetan, and covers an area approximately between 31°30′-39° N, and 81°-97° E.[8] The larger population concentrations are located in semi-arid alpine steppe habitats that feature grasses of the genus *Stipa*, a forage favoured by Tibetan ungulates (Schaller, 1998: 44-48; 2000: 22-28). In the central to western zones of this range, Tibetan pastoralists live in relatively close proximity to substantial antelope populations. Northern Gertse County[9] is one such area, and thus it was selected as a field site in which to study traditional antelope hunting as practiced by local pastoralists.

The history of the pastoralist communities of Gertse County is currently little known.[10] Like many northern Changthang populations, their origins are explained for the most part in terms of east-west migrations into the area. Of the four main tribal groups (T. *tsho-ba*) who inhabit the County – the Gertse (T. *sGer-rtse*), Drongpa Changma (T. *'Brong-pa Byang-ma*), Sengkor (T. *Ser-'khor*) and Pancik (T. *Pan-cig*) – the two former and larger tribes are, respectively, Amdo and Khams (i.e. *Nang-chen*) dialect speakers from eastern Tibet. The field study was conducted in the Amdo-speaking Gertse tribal area since they occupy the northernmost areas of the County. Gertse tribal origin stories recount how their ancestors migrated from an undetermined region of southern Amdo or northern Khams over 300 years ago and then settled in their present location to raise livestock. The reasons for their original migration are variously given as escape from local conflicts or pressing economic conditions, or even departure on pilgrimage to the holy mountain of Kangtisay (T. *Gangs Ti-se*, i.e. Mount Kailash) in far western Tibet. If the origin narratives are to be given any credence – and the linguistic evidence strongly suggests they should be – it means that the Gertse tribe originated from an area outside the currently known range of the Tibetan antelope. They must therefore have adapted to antelope hunting upon their settlement in northern Gertse County.

The Gertse tribe dwell, herd and hunt around and to the north of latitude 33° N, in an area lying east of the Aru Tso (T. *A-ru mTsho*) from longitude 83° E across as far as Gomo Tso (T. *sGo-mo mTsho*) at longitude 86° E. Northern Gertse County is a somewhat marginal environment for pastoralism when compared with other Changthang areas further to the east and south. Pastoral encampments are located up to an elevation of 5,000 m on semiarid alpine steppe and rolling hill country, with forage sparse in many places. Typically for the region, livestock numbers are subject to depletion as a result of unpredictable but regularly occurring natural disasters and predation. In this severe environment with marginal pastoralism, hunting has always served as an important form of subsistence, particularly in winter. In 1907, the Swedish explorer Sven Hedin passed through the research area and encountered the impoverished pastoralists of the northern Gertse tribe. He described their lifestyle as one heavily dependent upon hunting and eating antelope and other game because they possessed few livestock (Hedin, 1909, 1: 182, 187-190, plates 85-86). My elderly informants frequently reported dire poverty in many local families prior to the Chinese occupation in the early 1960s, and still today herd sizes tend to be considerably lower than in adjacent regions (Næss *et al.*, 2004). They stressed that hunting had always been a necessary survival strategy for every family, most acutely over the winter months. Up until the early 1980s, all local hunting was pursued solely for meat acquisition, with only a few other incidental uses of game animal products. The pastoralists have a common aphorism that captures the necessity of the antelope hunt for their survival: "If you kill a female antelope, you will have food. If you don't kill a female antelope, there will be no food!"[11]

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[8] Ethnographic evidence suggests that within living memory the eastern range of *Pantholops* was much further east than it is today, extending to the very eastern border of the Amdo grasslands in Kan-lho (Gannan). Elderly people from Kan-lho report abundant antelope in the region around the prefectural capital (longitude ca. 103° E) during the early to mid-20th century, and claim the area therefore received the name gTsos (a variant of *gtsod*, "antelope"; note here the "shawl of gTsos" in Karmay, 1975: 205; and Ladakhi "*stos*" or "*tos*", see Rizvi, 1999: 54). Reporting on the Brooke Dolan and Ernst Schäfer zoological expedition to eastern Tibet in 1934-1936, Dolan observed: "[T]he chiru have been persecuted like the yak and have withdrawn from the large areas formerly occupied by them to the wildest part of the high steppe…Schäfer encountered them only once while travelling for weeks over country where they were formerly plentiful" (Allen, 1938: 287).

[9] Field research was undertaken specifically in the rural administrative units of Shenchen (*Shan-chan*), Lugu (*Lu-gu*), Drapo (*Brag-po*) and Gomo (*sGo-mo*), all to the north of Gertse County town, and representing the northernmost pastoral encampments in the region. All of these areas lie on the southern boundary of (or actually within) the Chang Tang Nature Preserve (established 1993), which was established specifically to protect species such as the Tibetan antelope (Schaller, 1997).

[10] Only one short tribal history with any accurate detail has been published to date; see Karma Tshul-khrims (2003).

[11] *Gtsod a yu bsad na zas yod yin / gtsod a yu ma bsad zas med yin /.*

LOCAL ATTITUDES TO WILDLIFE

Before detailing the local hunting methods used in relation to one major animal of chase, we should attempt to understand the larger cultural context within which wildlife such as the antelope is thought of as being "game". The Gertse pastoralists do not just casually hunt any wild animals they encounter. They have their own specific cultural system for classifying all wild animal species, which define them as being either fit or unfit for both hunting and for human consumption. The local classification system has its own unique aspects, but it also shares certain of its taxonomic principles with more widespread Tibetan ways of thinking about wildlife. In most of these schemes, certain morphological characteristics of animals, especially the type of teeth and feet that they possess, serve as important indicators, along with aspects of their basic biology, such as diet.[12]

In Gertse, the fundamental division of wildlife is twofold: 1) those animals possessing long upper teeth (T. *kha yas so'i ri-dwags*), referring to both canines in carnivores and incisors in herbivores; and 2) those animals that lack large upper teeth (T. *kha mas so'i ri-dwags*). Animals with long upper teeth, including wild ass, fox, wolf, various wild cats, marmot, bear, rabbit and pika are considered unfit to both hunt and eat for a variety of reasons. The general perception is that it is very sinful (T. *sdig-pa che*) to hunt such animals for food, although wolf and bear are hunted as pest animals when they attack livestock. Some of their number are carnivorous and as such it is believed they may have at some time scavenged human corpses or remains, which makes them offensive. Others, especially the wild ass and wolf, are held to be too close in their natures to the domestic horse and dog, with whom humans form close working relationships, and which are both considered to have some feelings similar to human emotions.[13] Still others who dwell underground in burrows are negatively associated with the archaic cosmology. These species are considered to be too close to the realm of the local subterranean and sub-aquatic deities (T. *klu, sa-bdag, sri*, etc.), who are believed to be easily offended and also quick to cause harm to humans and their livestock in retribution for human encroachment upon their realm.

The so-called *kha mas so'i ri-dwags*, those lacking long upper teeth, are the permitted animals of chase and food. They are always numbered as a group of nine, known as the "nine game animals, father, mother and offspring" (T. *ri-dwags pha ma bu dgu*), and include the wild yak, Tibetan antelope, Tibetan gazelle, wild ass, argali sheep, musk deer, blue sheep, various deer species (T. *shwa-ba*), and rabbit. There are clearly some anomalies here, since not all of these animals occur on the northern Changthang (i.e. musk deer and other deer species), and the wild ass and rabbit are placed in both divisions of the system.[14] Rabbits are never hunted, and attitudes towards hunting and eating wild ass vary greatly, with some hunters feeling there is no problem with doing so, while others strictly avoid them as game, except in times of severe food shortage. With these exceptions aside, the larger ungulate herbivorous, such as the antelope, are the permitted animals of chase. They are considered the most fitting for human consumption, with their meat being thought of on a par with that of domestic livestock.

My informants often compared antelope meat to that of domestic goats and sheep. Whether it tasted good or not to an individual was not only a matter of personal preference, but also determined by the fat content of the meat, which is the same consideration used to judge mutton or beef as either good or poor in flavour and food value.[15] This is not the only commonality of classification the pastoralists hold between game animals (T. *ri-dwags*) and domestic livestock (T. *g.yung-dwags*). Parallel species are distinguished from both groups of animals, viz. wild yak vs. domestic yak, wild ass vs. horse, antelope and gazelle vs. sheep and goats, and they are named according to their age based upon identical criteria. For each year of life, a different name is given that is related mainly to the number of teeth and horn growth rings an animal possesses. For antelope, the Tibetan names used in Gertse are given in Table 1.

Curiously, this system could not be used accurately to distinguish animal age above about 3 years, since full adult dentition and male horn growth are reached by the third year according to biologists.[16] The naming system applied by the pastoralists to antelope is almost identical with the one they use for sheep and goats, the predominant livestock and meat source of the western Changthang, while the names for wild yak and wild ass are close to those used for domestic yak and horses

[12] For different Tibetan and Indic-influenced Tibetan classifications of animals, see g.Yu-thog Yon-tan mGon-po (1992: 54-55); Dung-dkar Blo-bzang 'Phrin-las (2002: 1097); Khu-byug (2002: 195-199); Krang-dbyi-sun (1986: 737, 2673).

[13] Specific prohibitions against eating horse meat, and notions about the pollution this produces, are ancient in Tibet; see Karmay (1975: 206).

[14] One could also point out that the musk deer male has a set of long, fang-like upper teeth, even though it is classed locally as *kha mas so'i ri-dwags*. However, since musk deer does not occur in the north-western Changthang, local pastoralists have little or no detailed knowledge about the animal.

[15] Several informants, one a traditional Tibetan doctor, related that game meat was more pure and healthy than most domestic meat. This is because game animals are thought to graze more exclusively upon mountain herbs that have medicinal properties and to drink only the purest water from snowmelt and remote springs.

[16] Schaller (1998: 62).

respectively.[17] As mentioned above, the antelope has no symbolic importance or high cultural status as a game animal among Tibetans. Its local designation in a manner almost equivalent to the most common domestic animals signals it as normal and neutral, another resource of the pastoral economy to be utilized when needed in common with sheep and goats.

In the minds of most ordinary pastoralists there is no great prohibition, sin or danger associated with hunting and killing game lacking long upper teeth (T. *kha mas so'i ri-dwags*) such as antelope. While most pastoralists still believe to some degree in the common Tibetan idea that all game animals are "owned" by the local territorial deities (T. *gzhi-bdag*, *yul-lha*, etc.), and represent the "livestock" of these beings (Huber, 2003), any tension between this idea and the taking of game in the hunt is neutralised through simple offering rites directed towards the local deities.

Institutionalised religion, in the form of monks, lamas and monasteries, is absent in most regions of the northern Changthang. Although the Gertse pastoralists all admit to being Buddhists, this has never placed any moral restraint upon their killing of domestic livestock or upon hunting. All such killing is viewed in practical terms as necessary for survival. It is typically only in old age that men who hunt develop a concern, in Buddhist cosmological terms, about the taking of life and its sotereological consequences. They no longer need to support their families with meat, and concentrate their energies instead on simple forms of Tibetan Buddhist ritual that are believed to help cleanse the accumulated sin of killing and to ensure a better rebirth. Close questioning of elderly informants revealed that all such current local attitudes and behaviours related to hunting and killing game have changed little since the Chinese occupation and the process of modernization in the region.

Tab. 1 - Antelope names by age.

Age	Male Names	Female Names	Notes
> 1 year	*gtsod-ris*	*gtsod-ris*	*Ris-thog* or *ri'u* are alternative names common to both sexes.
2 years	*sgam-gtsod*	*tshe-ris-ma*	*Rna-bzhi/ra-bzhi* are alternative names.
3 years	*so-bzhi*	*so-bzhi*	Meaning "four teeth", also used for sheep and goats. *'Them* and *'them-gsar* are alternative names, which mean "full" or "newly complete".
4 years	*so-drug*	*so-drug*	Meaning "six teeth", also used for sheep and goats.
5 years	*kha-gang*	*kha-gang*	Or *kha-tshang*, both meaning "full mouth", also used for sheep and goats.
6 years	*chib-gcig*	*chib-gcig*	Meaning "one *chib*" (or *chebs*, spelling uncertain). *Chib* is a measurement unit, which seems to relate to horn growth. It is also used for sheep and goats 6 years and older.
7 years	*chib-gnyis*	*chib-gnyis*	Meaning "two *chib*".
8 years +	*chib-gsum*	*chib-gsum*	Meaning "three *chib*".

ANTELOPE HUNTING TECHNIQUES

The pastoralists of Gertse and adjacent regions have a number of different traditional strategies for hunting the Tibetan antelope. These include the use of what could be called "road traps", also foot traps, blinds or hides, guns and food lures. The specificity and appropriateness of each of these methods can only be appreciated from the perspective of the overall ecology and behavioural traits of the antelope, to which the deployment of hunting techniques is closely linked. Most importantly, Tibetan antelope populations exhibit both migration and sexual segregation at different times of the year in a regular cycle, which runs basically as follows:

1. In late spring (approx. April-May) young male offspring born during the previous season separate from their mothers to join separate male bands.
2. In early summer (approx. May-June) adult females,

[17] It is to be noted that livestock age categories are also applied to wild animals by Kazakh and Kirghiz pastoralists of neighbouring Central Asia (personal communication, Ömer Akakça, Berlin, 2003).

accompanied by young female offspring, migrate far to the north to regular calving grounds in order to give birth.
3. By late summer-early autumn (approx. August-September) all females and their newborn calves return south again for autumn and winter grazing.
4. The rut occurs in early winter (approx. November-January), and both males and females gather together for mating, often at regular sites, which are used annually as wintering grounds.

The different antelope hunting methods in Gertse will now be explained in Tibetan terms in the same order as this annual cycle.

1. The marling hunt

The term marling (T. *dmar-gling*) refers to the late spring-early summer (approx. May-June) hunt undertaken when female antelope migrate northwards en masse to the calving grounds in order to calve together.[18] The element *dmar* ("red" as in "blood") here is explained as referring to the event of birth, while *gling*, which normally means "island" or a bounded "part" of something, refers to the "congregation" of all the females in one habitually defined area for the calving. This annual female migration and group birthing remains one of the least understood aspects of the Tibetan antelope's behaviour.[19] The Gertse people possess an intimate knowledge of antelope behaviour, and have many insightful stories and sayings about the dynamics of the separation of the sexes that occurs due to the migration process. For example, there is one such story of a migrating mother antelope about to separate from her young male offspring, who tells him with emotion and tears: "Now the time has come for mother to go to the north. If I don't get caught in a small trap, mother will return home again. If I don't get swept away by the Tsachi Tsangpo [river], mother will return home again. I must go to the north, and you must stay in the south."[20]

Because the Tibetan antelope migrates annually, the pastoralists characterize the animal as possessing a very fixed, almost rule-bound behaviour pattern (T. *khrims*). A local aphorism states, "The antelope's rules are like the bird's",[21] meaning that they both migrate regularly. From the hunter's perspective the migration itself provides an ideal opportunity to kill game since it is a very predictable annual event in the animal's life cycle. The pastoralists state that female antelope always follow exactly the same paths northwards year after year, and that younger females learn the routes from following their mothers. These so-called "antelope paths" (T. *gtsod-lam*) can be clearly seen in northern Gertse running along the centres of certain flat-bottomed north-south valley systems or crossing rolling north-south passes, both of which represent the type of smooth and gentle terrain which antelopes prefer to traverse. It is precisely at such places that the marling hunt is practiced.

Hunting the migrating female antelope requires the construction of a large type of "road trap" known locally as a "dzaekha".[22] To date, these traps have been found located in valleys and on passes between approximately 33°30'-34°30'N and 83°-84°30'E.[23] All 7 dzaekha sites visited during the research lay in valleys or on passes and hillsides with a generally north-south orientation and through which distinct animal paths are seen running. The construction and use of dzaekha as a specifically Tibetan hunting technique appears to be confined to the western Changthang (Rudok, Gertse, and part of Nyima Counties), and thus coincides with the region of the western antelope populations and their main migratory routes.

Dzaekha traps are formed by constructing two or more long lines of stone or earth mound cairns (T. *tho*). The cairns can range from 30-50 cm in height, most often comprising a simple pile of stones or a mound of earth. These are often topped by an erect stone marker or sometimes with the horns and skulls of dead animals or small trigs decorated with strips of old cloth set atop them.[24] These lines of cairns most often begin on opposite sides of a valley or pass and form converging diagonal lines, which meet near the centre of the level ground. Viewed from above, a typical dzaekha resembles a large funnel shape on the landscape with its narrow opening pointing most often northwards (see Fig. 1 and 2). Cairn lines were

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[18] Pastoralists call the northern calving grounds "the place the antelope are with their lambs" (*gtsod lu gu 'khrid sa*), but only a few elderly hunters claim to have a knowledge of the location of these sites far to the north on the Xinjiang-Tibet Autonomous Region border.

[19] See the recent popular account of a visit to one antelope calving ground by R. Ridgeway and G. Rowell (2003).

[20] *Da a ma byang la 'gro ba'i dus slebs song / a ma phra chung rnyi yi mā zin na / gtsod a yu a ma rang cag rang yul la log yong / chu rtsa skyi giang pos ma 'khyer na / a yu a ma rang cag rang yul la log yong / nga byang la ma 'gro ka med red / khyed rang lho la ma bdad ka med red /.*

[21] *Gtsod khrims bya dang 'dra /.* There is a secondary meaning here. Most nomads describe the female migration north to the calving grounds as occurring in tandem with another migration by a particular species of bird, also northward to the same location. The bird is named *byar-long*, although its identification remains unclear. A type of symbiosis is held to ensue between the two species in the calving grounds, since the birds consume the antelope's afterbirth (*phru-ma*) and the birthing females consume the bird's nutritious dung (*bya-skyag*). There is a saying about this mutual benefit, "The antelope don't have to thank the birds much, and the birds don't have to thank the antelope much" (*Bya drin gtsod la che rgyu med / gtsod drin bya la che rgyu med*).

[22] The spelling and etymology of the word is unknown. One possibility is *rtsed-kha*, where *rtsed* can mean to "entice" or to "play with", in the sense of leading animals along certain routes, and *kha* means the "mouth" or entrance to the trap where the snares are set in the ground.

[23] The only previous account of the occurrence of this type of trap in Tibet is a brief description by Hedin (1909, 1: 119-120; cf. also Hedin, 1913: 58). Its location, on the now disputed but Chinese occupied territory of Aksai Chin (*Ag-sa'i chen*), was the large plain to the west of the lake named *Sa-lr-skyid mTsho* (Hedin's "Yeshil-kul") at approx. 34° 40'N, 79° 35'E.

[24] Marinus Näess reports that old audio-cassette ribbon was fixed on top of cairns on a dzaekha constructed in the Aru Basin (personal communication, Oslo, 2000).

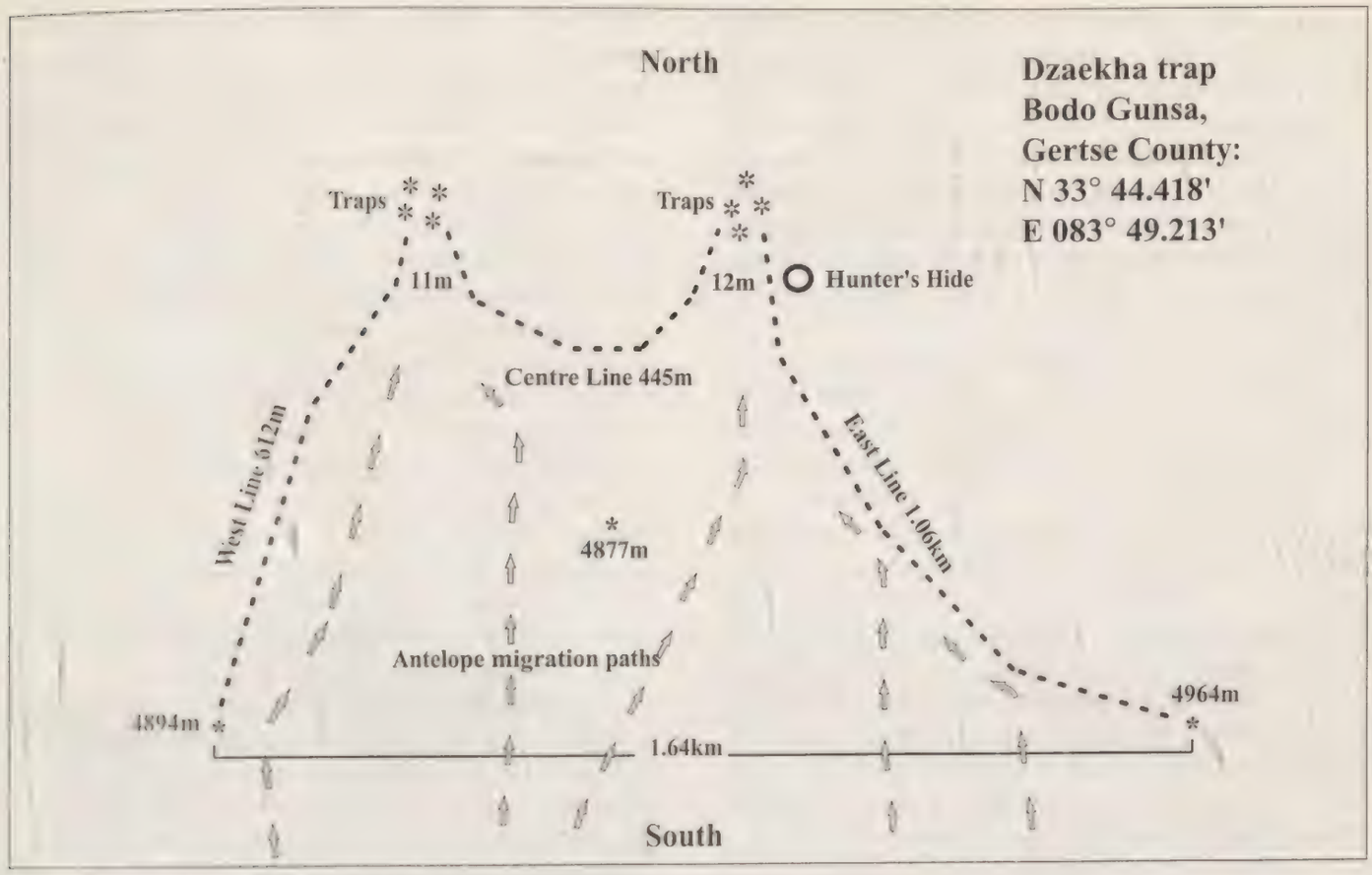

Fig. 1 - Plan view of a dzaekha trap at Bodo Gunsa.

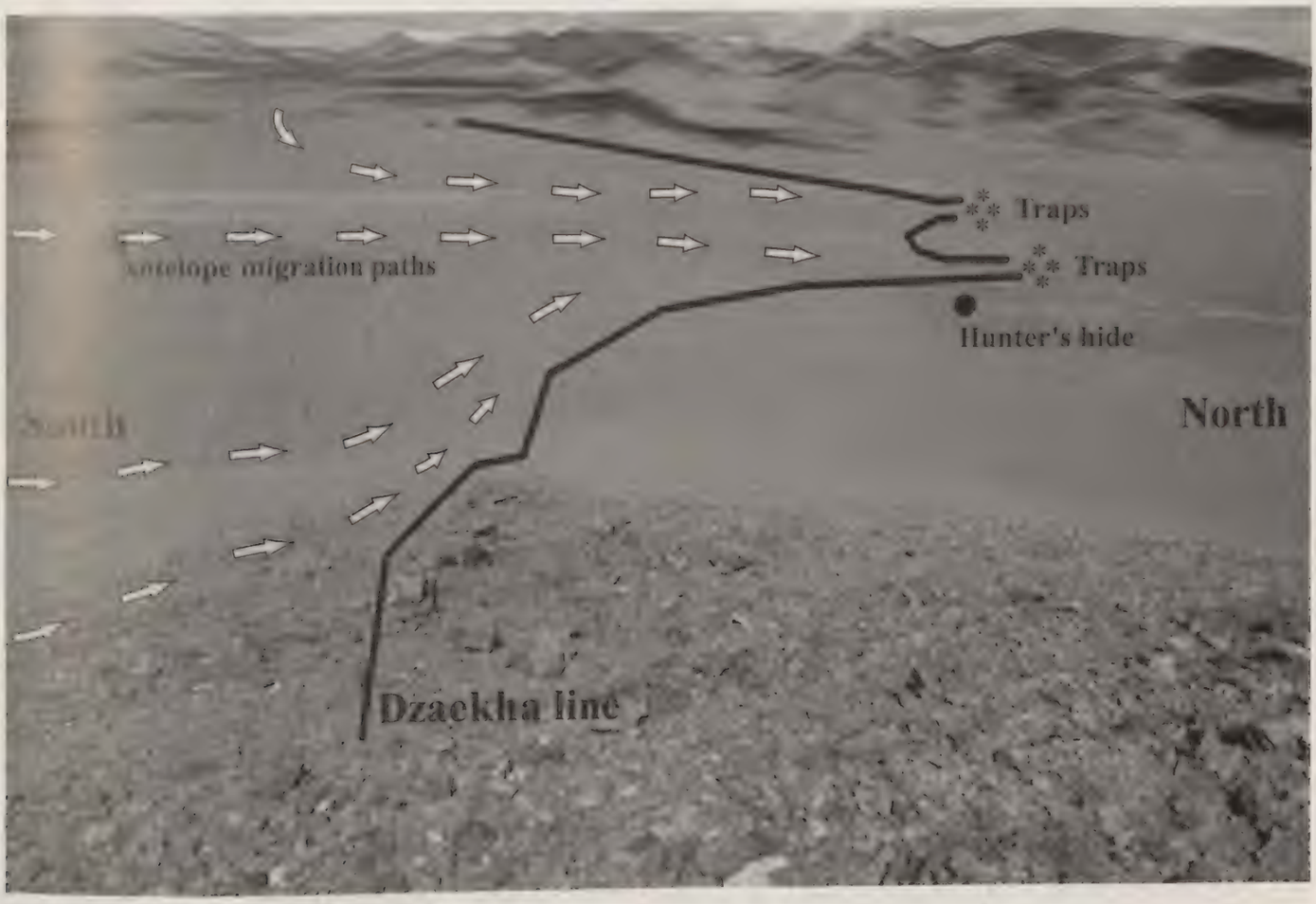

Fig. 2 - Location of a dzaekha trap at Bodo Gunsa.

measured from 270 m up to 1.06 km in length, and may be curved, straight or gently meandering. The lines of cairns never actually converge completely, but stop short to form an opening (T. *sgo*) or mouth (T. *kha*) between their end cairns, which usually measures about 5-10 m across. The wide, southerly facing opening of a dzaekha across a pass or valley can range from about 400 m up to 1.64 km. The cairns erected at the wide end of a dzaekha line are larger and more widely spaced apart (ca. 2-3 m), and as the lines converge the cairns become reduced in size and are located closer together (ca. 50 cm).

According to Gertse hunters, when northward migrating groups of female antelope enter a valley or cross a pass with a dzaekha, they catch sight of a line of cairns to one side of their peripheral vision. The cairns represent an obstacle to the animals, who prefer to walk on open flat ground rather than having to negotiate barriers, and they accordingly steer away from them to some degree and walk parallel. Similarly, the second line of cairns on the opposite side of the same terrain also has this steering effect on the animals' progress, and in this way they are coerced between the lines of cairns towards the mouth or gate ahead of them, which is free of obstacles. Any antelope, if it so desired, could effortlessly cross a dzaekha line or walk between its cairns, although the female animals seem unable to bring themselves to negotiate this particular type of manmade obstacle. In the open ground immediately at the mouth of a dzaekha, through which all antelope will pass, hunters place the foot traps known as khogtse. Normally from 5 to 20 traps may be placed in this area, depending upon the size of the dzaekha and the amount of traps a hunter or hunting party possess. As mentioned above, the khogtse is an ancient style of Tibetan ungulate trap, and all aspects of its present design, materials and dimensions as made by the Gertse pastoralists have remained unchanged when compared with the ancient specimens available. The use and construction of similar foot traps in Tibet is widely reported in the literature (Bower, 1894: 117; Rockhill, 1893: 714; Kennion, 1910: 235-6; Trotter, 1915, 1: 165; Goldstein & Beall, 1990: 126-127; Schaller, 1997: 70), and the present account only concerns the khogtse as found in the research area of northern Gertse.[25]

All adult male pastoralists interviewed in northern Gertse knew how to construct a khogtse. It is a skill they say they acquired already as young boys from their fathers and male relatives, and is considered necessary knowledge for survival. Once all the necessary materials have been assembled, the construction of a khogtse can be accomplished by a skilled person in approximately one hour. The khogtse is based upon a plaited ring of dry grass stems (T. *'o-mo rtswa* or *spur-rtswa*) mixed with the quills of geese (T. *bya ngang-pa*). Both these materials can be collected near local lakes and marshes. This strong plaited ring, with a thickness of 3 cm, is bound around with yarn made of sheep wool and goat hair, and has an overall diameter of about 20 cm. An antelope horn (T. *gtsod kyi rwa-co*) must then be soaked in water to make it pliable for cutting into thin slivers. The dried slivers of antelope horn, about 15 cm x 1 cm, with sharpened points, are inserted at an angle into the ring, such that all the sharp pointed ends meet in a funnel-like arrangement at the centre of the ring about 7-9 cm below its top surface. A total of 12-16 of these so-called "horn prongs" (T. *rwa-so*) are used in those khogtse which are made for snaring antelope and other smaller wild ungulates.[26] The use of antelope horn in the central part of the trapping mechanism of the khogtse is the subject of a well-known Gertse aphorism: "The tool for killing the antelope is on the head of the antelope."[27]

At the beginning of the marling, an antelope hunter carries all his khogtse to the narrow opening of the dzaekha and inserts them into the ground in an array about 1 m apart from each other. A shallow (ca. 25 cm) hole (*sa-long*) is dug in the earth using an antelope horn, and a khogtse is inserted into the top of this, with its circle of horn prongs pointing downwards into the hole. Once an antelope steps into the mouth of the khogtse, its foot slips down between the flexible, sharpened prongs and into the hole, and it is unable to pull itself free since the points of the prongs cut into its skin and flesh, holding its leg in position. In winter and in cold weather, the khogtse is held fast around the top of the hole since it is frozen solid to the surrounding soil. When khogtse are set in cold conditions, hunters often pour some water around the mouth of the hole to aid this freezing into position. Once frozen into position, a struggling antelope is unable to pull the trap loose.

If the surface of the ground is no longer frozen when a khogtse is to be set, then the hole must be dug somewhat deeper (ca. 50 cm or more), and an additional snare cum anchor rope (T. *rnyi-thag*) must be added to the trap. This additional rope is made of strong yak hair, with a 3 cm diameter and 1 m in length, and a loop and slip-knot formed at one end. The loop is laid exactly over the top of the khogtse ring when it is set into the ground. The other end of the rope passes down into the hole, and is anchored into place by being attached to a long stone (T. *char-rdo*) or antelope horn which has been wedged or frozen firmly into the soil at the bottom of the hole. Sometimes other stones can be placed on top of this anchor to ensure it can-

[25] In other pastoral areas of the eastern and southern Changthang, the khogtse is only ever found used in conjunction with a 2-3 cm diameter rope loop foot snare made of yak hair (called *rnyi-thag* or *nur kyi rdzi-pa* in neighbouring Nyima County, for instance; see Goldstein & Beall, 1990: 126, for a description). In these areas, the whole trap is frequently designated simply as a *rnyi* or "trap" and the word khogtse is not used.

[26] Khogtse are also used to snare wild ass (*rkyang*), and while their construction is identical, they are larger overall, with a total diameter of about 30 cm, a ring thickness of about 4-5 cm, and contain 20-30 horn prongs.

[27] *Gtsod gsod spyod gtsod kyi mgo la yod /.*

not be pull out by the struggling prey. If an animal managed to pull its leg with the khogtse out of the hole, the slipknot of the snare rope tightens fast around its leg leaving it unable to escape.

The opening of the khogtse is finally covered over with straw and a sprinkling of earth, or a pat of wild ass dung if available. In winter and during cold weather, when frost and snow cover the ground, the opening will be all but invisible to passing animals if so disguised. In summer, when it may frequently rain, the opening must be covered by something more durable. A pad of coarsely woven or felted horse or wild ass hair, called a "dirang", is placed over the opening and then covered over with grass and sand. Both heavy snowfall and heavy rain prejudice the effectiveness of khogtse traps.

During the height of the marling season, different sized groups of female antelope will migrate through the area of a dzaekha as often as every few days, and a hunter must visit the site at least several times a week to check for snared animals. The killing and processing of snared game will be discussed below. During the marling hunt, khogtse traps are only set in a dzaekha to snare antelope on the northward phase of their migration. They are removed in the early summer when all the pregnant females have passed through the area. According to hunters, returning females and their newborn young are never trapped, and the generally northern orientation of all the dzaekha that were observed during the research supports this claim.

2. The tshertsö hunt

The second annual antelope hunt is locally referred to as tshertsö (T. *tsher-gtsod*), or the period of the "afflicted antelope". The tshertsö occurs throughout the warmer months of summer from about June to September. This is the period when Changthang insect populations, the source of the antelope's particular "affliction" (T. *tsher-ba*), are most abundant and active. Gertse hunters remark that there are several species of summer fly which greatly irritate the antelope, and they are thus called "antelope fly" (T. *gtsod-'bu*). They reported that animals of both sexes and all ages are disturbed by these flies when they come close to their heads, especially during the hotter period of the day when insects are most active. These flies also parasitize antelope with their large larvae, which develop in the flesh and hatch out through a hole in the animal's hide. An antelope harassed by the presence of such flies may twitch and kick or buck in irritation. All the same details have been noted by biologists (Schaller, 1998: 57, 63-65).

Tibetan antelope have one well-known behavioural response to this summer insect irritation; they dig out regular hollows or bowls in the dust or sand by pawing with their hoofs, and lay down in them during the daytime. The hunters refer to these depressions, which are round, shallow and over a metre in diameter, as "affliction hollows" (T. *tsher-dong*). This particular behavioural strategy presents the hunter with another site of predictable – if temporary – antelope presence that he attempts to exploit. A hunter will search out sites where fresh antelope hollows have been dug, and set up an array of khogtse traps around them, such that an animal returning to their hollow may get snared. The use of the khogtse for the summer tshertsö hunting season is, as described above, always combined with a foot snare of strong rope (T. *rnyi-thag*) and the woven or felted hair pad (dirang) used to disguise the opening of the trap.

3. The kangtsö hunt

The kangtsö (T. *gangs-gtsod*) or "snow antelope" hunting season coincides with, and is closely related to, the tshertsö, although it begins later in the summer when insect harassment most disturbs the antelope. In Tibetan, the word *gangs* means "snow", but specifically it refers to snow of a more permanent nature, such as snow or ice fields that persist over summer high in the mountains or as glaciers. In order to escape both the insects and the heat of the plains, groups of antelope migrate up to the surrounding higher, cooler and relatively insect free ridges that may still have some remaining snowfields present on them. Here, high above the plains, antelope either stand or even lay on patches of ice or snow in order to seek relief. Since most areas of summer snow and ice occur regularly upon the same high ridges, antelope tend to visit the same easily accessible sites year after year. Local hunters search for well used antelope tracks leading up to sites of permanent snow and ice, and then set up khogtse along these routes from mid-summer onward. The trapping system used is identical with the tshertsö. It is reported that some very commonly used summer snow areas also have dzaekha established on their access trails by hunters, although no such sites were observed.

4. Ngartsö

The ngartsö (T. *ngar-gtsod*) is the principal period of the winter hunt, when antelope congregate for the rut between November and January. *Ngar* means "passionate", signifying the antelope's temperament and behaviour during the rut. But it also refers to the roar (T. *ngar-skad*) and the hoarse, strong breathing (T. *ngar ngar-po*) of male antelope during courtship. The rut is attractive for hunters for two reasons. Firstly, large numbers of antelope congregate together for courtship and mating and thus offer an easier opportunity for a kill. Secondly, November is typically the beginning of the more intense cold of winter when most water sources become frozen during the day, and it is also a period of very low precipitation. Thus, access to drinking water becomes a more critical factor for wild animals and this provides another predictable opportunity for hunters to obtain game. In addition to the better hunting prospects these conditions afford, the ngartsö is considered the best antelope-hunting season since the animals are at their fattest after summer and autumn grazing.

Some hunters state that male antelope become more confident and less cautious than normal during the rut, since

they are preoccupied with courtship and mating. The ngartsö is thus said to be the best time at which to stalk and shoot the animals with any degree of success. The introduction of firearms onto the Tibetan plateau during the 17th century surely revolutionized Tibetan hunting culture. However, the impact of guns on hunting in areas such as the Changthang should not be overstated. Although more advanced breech-loaders had been available in Tibet throughout the 20th century, they have been rare and expensive in remote areas such as Gertse. Some antelope hunters in Gertse have never used guns of any sort, simply because they have never been able to afford them. Until very recently, most antelope hunters have only used traditional matchlock-style Tibetan guns (T. *bod-mda'*). These handmade weapons fire homemade bullets when a smouldering wick is brought into contact with a charge of homemade gunpowder that is manually rammed into the end of the firing chamber. Discharging a matchlock produces a very loud report, a strong smell of burnt powder, and a following period for reloading which is seldom under 2 minutes duration. Due to this, it is extremely rare for a hunter to ever get more than a single shot at any animals that he has managed to come within range of. The accuracy of Tibetan matchlocks falls sharply beyond about 150-200 m. For these reasons, animal behaviour and environmental conditions during the ngartsö are considered to favour chances of shooting antelope.

Because antelope prefer to inhabit open plains and gentle rolling country, stalking (T. *'jab-mda'*) is very seldom if ever employed by hunters who use guns.[28] Shooting is almost always done from a stationary concealed location using simple blinds or hides that a hunter must construct at an appropriate site. During ngartsö, hunters carefully locate any sources of water close to the antelope's mating and wintering area that have not become frozen over. Having first observed that these are frequented regularly by the animals, they construct a hunter's hide known as a gugra (T. *sgug-ra*) within shooting range of a water source. The word *sgug-pa* can mean to "wait" or to "lie in wait", while a *ra-ba* is any kind of enclosure, fence or wall. A gugra is a shallow, circular pit (T. *sa-dong*) of ca. 2.5-3 m diameter and excavated to a depth of ca. 40-50 cm, in which a hunter can lay in wait with his gun. Arrayed around the edge of the pit, and facing the target zone, are a series of rocks arranged to form a low wall (T. *sgug-rtsig*). At intervals in this wall, small holes are left open between the rocks in order to place the barrel of the gun in and to take aim through when shooting. Because these constructions are mostly built next to water sources, they are also known as chugug (T. *chu-sgug*), which can be translated as "lie in wait [near] water". A hunter lies in wait inside the gugra during the periods he has observed animals regularly coming to seek water, and antelope are then shot when they stand and drink at the waterhole. Some hunters can lie in wait for a whole day at a time inside the gugra, while others limit themselves to mornings and evenings.

Hunting without a gun during the ngartsö is also based around water sources. This can take the form of setting khogtse traps around the favoured waterholes of the mating antelope, and returning every few days to check for snared animals. In some areas of northern Gertse where antelope congregate for the rut, there are no running water sources such as springs or rivers located on the plains or valley floors, and where khogtse and gugra can readily be set up. In such areas, the antelope drink mainly from small rivulets known locally as "sha", which carry melt water from snow or hail down the hillsides in shallow erosion channels. Hunters set up rows of 4-6 khogtse along the banks of such rivulets at 4-5 m intervals, often setting 20-30 traps in this manner.

5. The rutsö hunt

From mid-winter on, especially after the rut has ended in January, forage is often very scarce or buried under snow, and hunters say that antelope begin to get very hungry. This is when the so-called rutsö (T. *rus-gtsod*) or "bone antelope" hunting period begins. Hunters grind the dried bones (T. *rus*) of domestic livestock that they have gathered into powder. This bone meal is then taken and deposited on the ground close to the antelope wintering areas. As soon as antelope smell the powdered bone, they gather to eagerly consume it. Both khogtse and gugra are set up within range of these sites, and antelope are either snared or shot while feeding on the bone meal.

We have now identified the five main antelope hunting periods of the annual cycle in Gertse, together with their attendant strategies and techniques, according to Tibetan informants and our own observations. It should be emphasized that no hunters exploit all of these hunting periods one after another throughout the year. In fact, most hunters normally focus upon only one or two hunting periods during any given year. Exactly when, how and for how long an individual pastoralist engages in antelope hunting is determined by a variety of factors, including food needs, labour and time constraints of the domestic environment, weather conditions, occurrence of game, and economic interests. The only pattern that emerged during interviews was that most hunters who only sought antelope occasionally each year preferred to do it during the ngartsö or winter rut season. The main reasons given for this were that they had more free time in winter and the antelope were also in peak condition. Most hunters said they hunted antelope alone, while large prey, such as wild yak, was best pursued with a partner or group and pack animals.

[28] It is for the same reason that hunting dogs (*sha-khyi*) are never used to hunt antelope, since they are unable to corner them in open terrain. According to traditional pastoralist wisdom, antelope can recover from exhaustion after running up to 18 times, while domestic dogs cannot match this. However, wolves, they say, can recover 19 times and thus are a treat to antelope.

PROCESSING THE KILL

The khogtse is locally regarded as a particularly good type of trap because it inflicts neither severe injuries nor death upon a trapped ungulate. Once an animal is snared, it remains alive and, despite its initial panic, usually in good condition for several days. The hunter's main concern to regularly check traps is that predators, especially wolves, may get to the snared animals first. In addition, an already dead and stiff or frozen animal carcass is much harder to process and transport. Any animal which is found caught in a trap will be quickly killed by being hit on the head with a large stone, often, as much as anything, in order to save expensive or scarce bullets and gunpowder.

Once dead, an antelope is disembowelled, and then skinned. The skin is kept in order to harvest its fine wool, although the quality and quantity of wool varies considerably by sex, age and season of harvest. In times of hunger, all internal organs (T. *nang-cha*), including the stomach and bowel when cleaned of their contents, are retained for eating, especially if they have abundant fatty deposits on them. Otherwise, they are not necessarily eaten and may be disposed of near the site of the kill. If more than one animal is snared at one time, and a hunter is working alone, the additional animals will be killed and gutted immediately, and then buried in shallow graves to hide them from predators until the hunter is able to return and collect them.

If a hunter has pack animals, the processed antelope carcass (T. *sha-khog*) will be transported back to camp in one piece, and even a hunter lacking pack animals will simply carry the whole carcass on his back. Evidence of Tibetan hunting traditions from many other areas of the plateau reveals that hunted game is usually dismembered directly at the kill site. This appears to be due to concerns about the traditional rules for sharing the meat of a game animal and notions about the inauspiciousness of whole game carcasses entering the domestic environment of the tent or household. The transportation of whole antelope carcasses in Gertse contradicts this pattern, although, as in other regions, female members of the household are generally forbidden to touch the meat of antelope until it has been completely dismembered.

KILL RATES

Although all hunting techniques are designed to maximize success in killing wild animals, we should not forget that so much governing the success or otherwise of hunting is still ultimately a matter of pure chance. It is not possible to give any statistically accurate evaluation of the average annual or seasonal numbers of antelope killed by Gertse hunters. There is considerable variation reported between individual hunters and also from year to year. Individual kill rates that were admitted during interviews ranged from 2 to 23 animals per year since the 1950s, although most were towards the upper end of this range. Younger hunters were extremely reticent about admitting their recent annual kill rates because antelope hunting is illegal and within the past few years it has become increasingly strictly policed in Gertse County.

TIBETAN USES OF THE ANTELOPE AND THE SHAHTOOSH TRADE

For as long as any Gertse pastoralist can remember prior to the 1980s, antelope had been hunted solely as a supplementary food source in times of need. This is indeed confirmed in the few relevant historical sources that are available. Since antelope meat has always been consumed directly by hunters and their immediate social groupings, it has never had any commercial value.

The horns of antelope are locally used for a number of practical purposes. They are often utilized as tent pegs, and as tethering stakes for horses. They provide an excellent digging tool, with which pastoralists excavate holes (for traps, fire-pits, etc.) and to dig for the small edible tubers known as "droma" (T. *gro-ma, Potentilla* sp.). Some men also use the horns for the prong rests which swing down and support the barrels of their matchlock guns when shooting. While antelope horn and blood are both known as ingredients used in the Tibetan and Chinese traditional medical systems, the northern Gertse pastoralists have never used them in this way, and have never been asked to provide them for this purpose.

Although most parts of the antelope have nothing other than a functional value for the local pastoralists, the very fine antelope wool known as shahtoosh, or "tsö kulu" in Tibetan (*gtsod khu-lu* or *gtsod-khul*; "*stos kulu*" or "*tos kulu*" in Ladakhi), has attained an extremely high commercial value. The demand created by the modern luxury fashion industry for Tibetan antelope wool, and the subsequent excessive hunting of the species in recent decades, have rightly made *Pantholops* a cause célèbre of international conservation efforts. What is often forgotten in the documentation surrounding this issue is that Tibetan communities who have hunted the antelope for many centuries have never had a use for antelope wool in their traditional culture. The harvest and commercial disposal of antelope wool from regions such as Gertse has always been stimulated by purely exogenous economic interests.

The period of excessive hunting of antelope for their wool began only 20 years ago, and the international forces that drive it have now become well documented (Wright & Kumar, 1997; Schaller, 1997: 91-95). What remains little known, is the nature of the kulu trade in Tibetan areas prior to the booming interest that began in the mid-1980s. There was only a residual kulu trade in

Changthang areas for the first 20 years of the Chinese occupation, that is, up until the 1980s, because cross-border trade with neighbouring India had been reduced significantly due to political and military tensions. Prior to this, in the 1950s and earlier, merchants had arrived annually in Gertse from Ladakh, in order to trade with local pastoralists.

Several elderly informants gave accounts of the kulu trade in Gertse during the 1940s and 1950s. The best quality kulu was always obtained from antelope hunted in the spring, during the marling hunting season. Ladakhi traders from Leh traditionally visited the area in the mid-summer months with small caravans of 10-20 donkeys. Their main objective was trading in sheep and goat wool, but they had encouraged the Tibetans to trade kulu with them for generations. This was no wonder: it has been calculated that such pre-modern traders could make up to 1,000% profit on the resale of Tibetan kulu (Rizvi, 1999: 90). Since antelope were hunted on a purely subsistence basis, very little kulu was ever collected by the pastoralists. Once an animal was killed, it was skinned and the kulu was hand-plucked from the dried hide. The quantities were measured in small units locally known as nyaga (T. *nya-ga*), equal to approximately 250 gm. Tentholds that actually had some kulu to trade could only provided about 8 nyaga (= 2 kg) per season at most. There was no fixed price for kulu, and Tibetans obtained a variety of goods in exchange, including wheat flour, roasted barley flour, rice, dried fruits, lead for making bullets, ingredients for making gun-powder, and raw sugar. One informant regularly took a salt trading caravan from Gertse to Gyanyima (T. *rGya-nyi-ma*) on the Indian border each summer. During the 1950s, he was able to get up to 100 Indian rupees for 3 nyaga of kulu by dealing directly with Kashmiri traders.[29]

The above information indicates that the antelope wool harvest and trade from areas such as Gertse was always rather insignificant prior to the 1980s. It did not stimulate an increase in local antelope hunting. This only took place when a remote and fairly impoverished Tibetan community became exposed to the powerful forces of an international economic system. When pastoralists were suddenly offered very large financial rewards for antelope hides, a number of them shifted from being subsistence hunters to hunting for profit. Such increased local hunting for profit, and a great deal of organized poaching by outsiders, has lead to a dramatic reduction in the antelope population across northern Tibet.

AFTERWORD

Since early 2002, police and officers of the TAR Forestry Department from Gertse County visited every rural district and confiscated all firearms and khogtse traps in the possession of local pastoralists. The seized hunting equipment was then destroyed by the authorities. The policing of existing conservation laws has also been vigorously stepped up during the past few years. Prior to this, hunting had already been banned because northern Gertse lies within the Chang Tang Nature Preserve, although low levels of subsistence hunting had been quietly tolerated by the authorities as a necessary meat supplement for poor households. The removal of the hunting option for pastoralists will have negative economic effects in this already marginal environment, and these must be addressed if an effective and manageable balance between wildlife conservation and human needs is to be maintained in the region over a longer duration (Næss *et al.*, 2004; Fox *et al.*, 2004).

The political and ecological consequences of the past two decades of externally stimulated excesses in antelope harvesting have led to the effective end of a local Tibetan hunting culture throughout Gertse County and neighbouring areas for the foreseeable future.

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[29] Cf. Rizvi (1999: 93), who quotes 120-170 rupees per bhatti (1 bhatti =1.87 kg) being paid for kulu by Ladakhi merchants from the same period.

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Wildlife and plants in traditional and modern Tibet: conceptions, exploitation and conservation
Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano
Volume XXXIII - Fascicolo I

Francesca Cardi

Evolution of Tibetan medical knowledge in the socio-economic context: the exploitation of medicinal substances among traditional doctors

Abstract - For their traditional activities Tibetan populations have always been relying on natural resources. All over the Himalaya and in Tibet many independent doctors still carry on their profession according to the traditional Tibetan medical system. For their practice, doctors have always depended on natural resources and specifically on medicinal substances such as plants, animals and minerals, which are exploited through specific procedures and timings. The medical activity has always represented a sustainable form of exploitation and has contributed for centuries to the well-being of the whole Tibetan community. Nevertheless, due to recent development policies, new regulations, demographical pressure and socio-economic strategies, the exploitation of natural resources is changing. As a direct consequence medical activities evolve as well. The competition with modern medical institutes and several practical problems are jeopardising the profession of independent doctors, who are sometimes compelled to convert their activity into a business. Moreover, a general trend of medical institutes relates to the standardisation of the medical knowledge, simplification of procedures and transformation of the doctor's career, which finally results into a depauperation of and a threat to the traditional medical culture.

Riassunto - Le evoluzioni del sapere medico tibetano nel contesto socio-economico: lo sfruttamento delle sostanze medicinali da parte dei medici tradizionali.

Per la loro sussistenza e per lo svolgimento delle attività tradizionali, le popolazioni tibetane sono sempre state legate allo sfruttamento delle risorse naturali. Basandosi sui principi fondamentali della scienza medica tibetana i medici tradizionali contribuiscono al benessere delle varie comunità tibetane. La loro professione comporta l'utilizzo di sostanze medicinali: piante, animali e minerali che vengono sfruttate secondo regole e tempi prestabiliti. Lo stato delle risorse e i metodi di sfruttamento sono oggigiorno influenzati dalla situazione socio-economica, dall'incremento demografico e dallo sviluppo cui queste regioni sono soggette. Per quel che riguarda l'attività dei medici tradizionali indipendenti, la competizione con gli istituti medici moderni risulta essere sempre più forte; altre problematiche riguardano inoltre la standardizzazione delle pratiche e la trasformazione delle carriere. Questi cambiamenti sembrano purtroppo determinare un generale impoverimento della cultura medica tradizionale e la scomparsa di alcune attività ad essa collegate.

INTRODUCTION

The exploitation of medicinal substances in Tibetan regions

Throughout Tibetan regions, the exploitation of plants and animals represents an important activity for local populations, since it provides a source of income and wealth. Some of these substances are employed in Tibetan medicine and their use is connected with traditional culture and livelihood of Tibetan populations. However, as a source of income, natural resource exploitation provides wide economical interests and brings benefits also to non-Tibetan populations. Unfortunately, as a direct consequence of trading activities, the ecological stability is sometimes at risk, natural resources are jeopardized, and the survival of plant and animal species is threatened. Statistics prove that in different regions the quantity of natural produces included in the medicinal and aromatic plant trade list is increasing, but that the annual harvest amount far exceeds the domestic demand.

Medicinal substances coming from the Himalaya and from Tibet are traded both at national and international level. Within Asia, plants are traded from Pakistan to Bhutan and from North of the Himalaya to India and South-East Asia (e.g. Olsen, 1998; Rai *et al.*, 2000). The value of plants exported from Nepal to India in 1997/98, including legal and illegal export, is estimated around US$ 643,000 (CBS, 1999). According to statistics, China represented, between 1991 and 1995, the world leader country in the plant export for the pharmaceutical industry (Kuipers, 2003). In different part of the world pharmaceutical companies have already being engaged in standardised researches in order to discover new therapeutic principles throughout the analysis of traditional pharmacopoeias. The commercial value of the produce may greatly rise according to the international demand. As far as Tibetan populations are concerned, this situation may also affect local drug trade and hence traditional medical activities. As a result of the market quotations, medicinal specimens that possess commercial value may be subject to indiscriminate chase, which can lead to overexploitation and biodiversity loss. Alarming levels for the ecological stability are in particular achieved when the gathering activity is organised and supported by powerful investors. In western Sichuan, the second largest forest resource of China, past exploitation has consistently depleted this reserve. However, after the ban of 1998 that prohibited tree felling all over China, reforestation projects and programs of protection of wild animals and plants have been implemented in the region. In addition, plantations of medicinal plants and fungi of economic value (as

Hippophae spp., *Phyllanthus* spp., and *Tricholoma matsutake*) have been established and animal husbandry enterprises have been supported, for example musk deer (Rongsen, 1998).

The situation in different alpine regions of Nepal and North West India is not dissimilar from the Chinese one as far as environmental problems are concerned. Almost all species gathered grow in the wild and are taken to the South along an historical well-established trade channel that goes from the hills to the Terai plains and then to India. (Rana & Ashok, 1999). Along with the increasing demand of plant produce and a general improvement of local communications, recent studies report that another reason of the increasing exploitation of forest resources relates to a massif movement of the traders closer to the source (Olsen & Helles, 1997; Subedi, 1999; Olsen & Overgaard, 2003). In different Tibetan regions of Nepal, alpine medicinal plants that are used in Tibetan medicine are rare or considered at risk. In Dolpo (West Nepal), *Aconitum spicatum*, *Incarvillea mairei, Lagotis kunawurensis, Meconopsis paniculata, Nardostachys grandiflora, Picrorhiza scrophulariiflora, Podophyllum hexandrum,* and *Valeriana jatamansi* are only a few of the species that are seriously threatened (WWF, 2000). Some of the plants used for medical purpose are already included in the CITES appendices of endangered and protected species (CITES, 2005) and their trade is subject to regulation (such as in the case of *Nardostachys grandiflora, Podophyllum hexandrum, Picrorhiza scrophulariiflora, Valeriana jatamansi, Euphorbia royleana*), while other plants might be included in this list soon (such as *Aconitum heterophyllum, Rheum australe,* and *Gentiana kurroo*).

The importance of natural substances among Tibetan populations

Nature represents a crucial resource for the life of Tibetan communities that still live in a traditional way and in particular to those living in remote areas. Nomadic groups are a perfect demonstration of how deeply the culture of Tibetan populations is connected with nature and depends on it for survival. The environment constitutes a living habitat, whose resources may be exploited for various requirements as food, firewood, timber, livestock production, and trading; moreover, it is significant in several cultural and social aspects of Tibetan life. According to the Buddhist religion, human beings must respect the environment and live within it in a state of equilibrium and with the complement of the animals and the rest of nature.

Medicaments represent a major therapeutic remedy of Tibetan medical science, whose fabrication implies the exploitation of natural resources, in particular the gathering of medicinal plants and, at a lesser extent, of animal and mineral substances. This type of exploitation is spread all over Tibetan cultural regions: several Tibetans are directly involved into it, while others simply rely on it and on the Tibetan medical system exclusively for their health. This activity is related both to environmental and socio-economic problems. How do Tibetan doctors exploit medicinal substances? Do they employ resource-management systems? Are they concerned about the general ecological situation?

Methods and procedures adopted by Tibetan doctors will be analysed in different sections of this paper. Although practitioners living in different regions do not exploit natural substances exactly in the same way, general assumptions may be taken. Some of the data included in the article are part of a major research project on Tibetan populations that I have carried out from 1998 to 2002 in different Tibetan regions of Nepal, India and China, and has led to my doctoral dissertation (Cardi, 2004). During the fieldwork, I mainly focused on medical activity and interviewed Tibetan traditional doctors in order to describe the utilisation of the *materia medica* and the preparation of remedies. In addition to general information about medicinal resource management, I will point out several problems that I could observe on the field or that have been reported by traditional doctors. Some problems are related to cultural transformations, others to environmental and socio-economic changes, which have been affecting medical activity.

FEATURES AND PROPERTIES OF THE *MATERIA MEDICA*

According to the Tibetan medical science, the concept of medicine *sman*[1] refers in general to a substance which is useful to cure illness and therefore possesses the healing potency *nus pa*. It is important to point out that medical doctrine and Buddhist philosophy are strictly interconnected. According to the latter, the presence of a healing potency is innate in all natural substances: traditional doctors affirm that Buddha created all medicinal substances on earth to cure all diseases and alleviate human pains. Curative properties and other important characteristics of the *materia medica* are described in Tibetan pharmacology according to the eight potencies (*nus pa rgyad*), the six tastes (*ro drug*), the three post-digestive tastes (*zhu rjes gsum*). In addition, allopathic and homeopathic theories are both involved in the mechanism of attribution of therapeutic properties. Symbolic and religious criteria may also influence and sometimes determine drug therapeutic properties, in particular morphology: correlations and affinities between forms and functions of drugs, between other natural objects and the diseases to be cured are sometimes established. For example, different types of beans, *mkhal ma zho sha* (*Canavalia gladiata, Phaseolus lunatus*) are related to kidney pathologies in conformity of their typical shape that recalls these organs. A similar case is represented by *ug chos* (*Incarvillea grandiflora*), a plant renowned for cur-

[1] Transliterations are carried out in the text according to the Wylie system (Wylie, 1959).

ing ear-sickness and whose flower corolla is similar to the human ear. A correlation may be established between the therapeutic activity of a drug and its function *in vivo*. That is the case of several animal organs (classified in the *srog chags sman* category, the medicinal substances that come from living beings) which are employed in medicine to cure diseases that affect the same anatomical part: liver cures liver, skin cures skin, lungs cure lungs, etc. The skin of the snake (*sbrul lpags*) heals indeed skin infections. Some plants extracts are employed in therapeutics to alleviate specific correlated diseases: the resin of various trees such as *shel ta* or *shug pa thang chu* (respectively the resin of different *Pinus* and *Juniperus* species), owing to their property of sticking, are employed to cure joint and leg ailments.

Therapeutic properties of natural substances are reported in traditional Tibetan texts of *materia medica* like *Shel gong* and its commentary *Shel phreng* (De'u dmar dge bshes bstan 'dzin phun tshogs, 1994). Drugs are described according to their taste and potency or directly for their beneficial activity for a specific pathology. Medicinal substances are commonly used in Tibetan medicine to prepare different types of medicaments (decoctions, pills, powders, etc.) that relate to several complex formulas. Every pharmacological remedy is produced by a predetermined methodology and includes a number of drugs varying from 5 up to 80. Within the medicines, the pharmacological activity of drugs is coordinated and results in a synergic, antagonistic or modulatory action. Pharmacological treatments are particularly important in Tibetan therapeutics, but do not represent the only type of remedy employed by traditional doctors. Other kinds of external treatments such as moxa, bloodletting, cauterisation, and acupuncture may be adopted as a stronger therapy. Moreover, to relieve particular diseases that are caused by demons or evil spirits, religious practices may also be employed. A therapeutic strategy generally involves different medicines and types of treatments, which are strictly correlated with the patient general condition, age, sex, etc. Furthermore, according to local traditions and to the individual knowledge of the doctor, the hierarchy between the treatments may change. Generally, stronger treatments as moxa and cauterisation are prescribed in rare cases, the major remedy being represented by medications. However, such external treatments seem to be recurrent in some areas of Ladakh (India) and are frequently used by some practitioners of Sichuan (P.R.C.) that often employ them even at the beginning of the therapy. The reasons of this trend seem to be: a limited availability of some types of drugs in the region, limitations in the production of the medicines also relating to economic problems.

Fig. 1 - *Incarvillea grandiflora*, Sichuan (P.R.C.).

FACTORS INFLUENCING THE UTILISATION OF THE *MATERIA MEDICA* AND THE PRODUCTION OF MEDICINES

The availability of drugs

The availability of drugs in the area where the practitioner carries out his activity, and other aspects strictly related to the supplying of medicinal substances, strongly influence the whole process of production of the medicines. The availability certainly represents a major critical aspect of the exploitation of medicinal substances by traditional doctors. Two major features influence it: the extension of the Tibetan territory and the considerable amount of medicinal substances listed in the Tibetan *materia medica*.

The distribution of the territories inhabited by Tibetan populations over a vast area of more than 2,5 million km^2 implies the significant difference of the environments that can be exploited. So forth, this variability also characterises the substances that are employed in therapeutics, which belong to plant, animal and mineral kingdom and come from different habitats. Many varieties listed in the *materia medica* spread over Tibetan and Himalayan regions and several come from tropical and subtropical regions of Nepal, India, and China. It is known that the Tibetan pharmacopoeia has been created on the basis of Ayurvedic texts, which have spread to Tibet along with Buddhism since the beginning of the VII century, and which have undergone successive adaptations to the local environmental conditions. As a matter of fact, through the analysis of the Tibetan *materia medica* we notice that many of its elements are not endemic of Tibetan regions, as the so-called "three fruits" (*'bras bu gsum*): *Terminalia chebula*, *Terminalia bellerica*, and *Phyllanthus emblica*, plants that thrive in subtropical regions up to 1,500 m of altitude and that are important drugs also in Ayurvedic medicine. Several medicines of mineral and animal origin are not spread in Tibetan regions and have to be imported, such as jade (*khyung skyugs*), diamond (*rdo rje pha lam*) and some types of shells (*Monetaria moneta*, *'gron bu*) and conches (*Rapana bezoar*, *dung*). Among animal

substances I point out the horn of the rhino (*bse ba, Rhinocerus unicornis*) and the tiger[2] (*stag, Panthera tigris*) whose trade is besides restricted by the law.

When we observe the local flora of Tibetan regions we notice that it is quite homogenous. Moreover, surveys conducted in different Tibetan regions of Nepal, Tibet, India, show that the plants employed by the doctors are similar. Botanical classifications carried out in different Tibetan regions also show that dissimilar species may sometimes be exploited according to plant distribution and because a few species grow exclusively in some areas. That is the case of *bya rkang,* which corresponds to different species and precisely to *Delphinium grandiflorum* in Nepal, to *Delphinium caeruleum* in Litang, and to *Delphinium cashmerianum* in Ladakh. Sometimes, plants belonging to different genera are locally designated by the same Tibetan name and are also employed in a similar way (see Boesi & Cardi, 2003). As a matter of fact, doctors' exploitation of medicinal substances is considerably influenced by the availability of drugs in every specific context. The observation of the medical activity in different Tibetan regions reveals that an irregular number of these drugs is directly collected by practitioners in their homeland, the rest comes from marketplaces[3]. Seasonal trips are generally organised by doctors in the surrounding areas to gather all sort of plants, but it also happens that some of them prefer to ask local traders or friends to provide medicinal substances from other regions.

Features affecting the quality of drugs

The quality of the drugs influences the way Tibetan doctors carry on the exploitation of medicinal substances, representing a second crucial feature of the acquisition process. Quality is tested by practitioners either if the drug is bought or directly collected, and in both cases the appraisal of the quality represents a requisite for choosing or discarding a drug. According to drug typologies (plants, stones, earths, animal substances, essences, salts)[4], features influencing their general properties and qualities are evaluated on the field by practitioners. Among these, I will point out the general aspect of the substance and its colour, both providing a good evidence of the conservation state. Especially for the drugs that are purchased, their general condition represents a very important parameter of selection. The container used to stock them, the light, the temperature and in particular the humidity to which drugs are exposed are considered essential features. When a vegetable drug shows a bad conservation state, it presents deterioration marks such as the ones of parasites on leaf blades, small holes on the wood parts, etc. These are interpreted as signs of bad quality and the drug is discarded. Also the period in which the drug has been kept in stock before being sold or employed in medicine represents a key information: this is valid for substances of animal origin and plants. During the drug selection, practitioners always evaluate the presence of pharmacological properties and therefore try to choose the fresh ones or those which are not older than one year. Due to their particular essential nature (*ngo bo*), which is permanent, mineral substances are not affected by expiration problems and may be employed in therapeutics for years. For some mineral drugs, their selection is related to a few important prerequisites. Several substances have to be purified (*dug 'don pa*) through a specific and complex process before being used in therapeutics due to the presence of poisonous principles. However, practitioners frequently avoid carrying on purification process of mineral substances individually because of practical problems.[5] Doctors should therefore be acquainted with the treatments previously undergone by these substances. As concerns medicinal earths, because of their particular nature, doctors should obtain them always from a selected and clean environment in order to avoid they might be polluted. Examples of medicinal earths are the following: *gser gyi bye ma* (*Vermiculitum*) and *mu zi* (sulphur).

The quality is also useful to classify drugs, which can be identified through a specific terminology used both in texts and by the doctors. Tibetan expressions *dman pa, mchog*[6] and *'bring,* respectively point out inferior, high and intermediate quality of medicinal substances. Quality is furthermore determined by other important factors related to symbolic and religious evaluations, which influence the way drugs are utilised by traditional doctors.

Another aspect to be considered during the acquisition process is the place of origin of medicinal substances. The provenience of a drug is useful as a general information about its quality and can be used by doctors to select or to identify drugs. Moreover, it is also proved that the origin directly influences therapeutic properties of drugs. As shown in traditional texts, the origin can be related to either the geographical provenance of a drug or its supernatural features or the way the substance has been created or the three of them. The *materia medica* is sometimes described according to its place of origin or, in the case of medicinal plants, to the place of growth. *So ma ra dza* (*Cannabis sativa*) is for example indicated in traditional texts as a drug which prevalently comes from India (*rgya gar*) or from lower regions of Tibet (*lho mon*). The expression *rgya nag* is used instead in the texts to indicate the Chinese provenance.

A medicinal substance may also be described as a kind of magic object created by the wish of a superior entity,

[2] Several organs of the animal can be utilised in Tibetan medicine as the bones, the flesh and the fur.

[3] See further in this paper the section which concerns the drug market.

[4] Plants are included in the categories of *sngo sman* (herbaceous medicines), *shing sman* (medicinal woody plants) and *thang sman* (medicines of the plains). The other categories are in succession *rin po che'i sman* and *rdo sman* (precious medicines and medicinal stones), *sa sman* (medicinal earths), *srog chags sman* (medicines coming from living beings), *rtsi sman* (medicinal essences), *tshwa sman* (medicinal salts).

[5] Purification process are also provided for different types of substances of the *materia medica*. Several plants have to be detoxified before their utilisation like in the case of *bong nga nag po* (*Aconitum kongboense*) or *ko byi la* (*Strichnos nux-vomica*) (see Cardi, 2004).

[6] The term *mchog* (superior) is employed in the list in a general sense, which does not necessary relate to a symbolic characteristic of the drug as for the examples reported in the text.

as in the case of a type of pearl named *rak ta mukti ka* or "red pearl". The pearl originates as a jewel from the mouth of a red creature representing Buddha. In the case of *Cassiope fastigiata*, a dwarf evergreen shrublet, its origin is related to a Dakini, a female divinity with extraordinary powers. Its leaves are considered the Dakini's hairs arranged in the typical plaits thus that the plant is designated *mkha' 'gro spu skra* "the hair of *mkha' 'gro*". Always relating to the origin, some medicinal substances are reported to be typical of a few important religious sites. A type of renowned magnetite (*khab len*) comes indeed from sacred Mount Kailash, while for another stone, a type of jade (*khyung skyugs*), its name relates to the way the substance originated and precisely to the moment when the mythical bird Garuda has brought it from Mount Meru.

In general, these accounts do not simply inform us about the variability of the *materia medica,* but also about the therapeutic properties of its constituents. It occurs that drugs presenting a mythical origin or deriving from a place with a symbolic or religious signification are considered of high quality by practitioners. A drug may be granted with a symbolic value also in relation to its employment in other disciplines outside the medical field and in particular in religious practices. In the case of a type of conch (*Rapana bezoar*) *dung,* this is for example related to religious ceremonies because traditionally employed by Buddhist monks as a sort of liturgical and musical instrument, which indicates special moments of the day and of ceremonies. This conch is characterised by strong symbolism and consequently it is included among the substances of the *materia medica* that are considered precious (*rin po che'i sman*). A special type of the above conch called *dung mchog* is characterised by a mythical origin and its therapeutic properties result increased both by the origin and by the symbolic signification. In addition, the potency of a drug directly relates to the religious power that originates from the prayers of the devotees (*smon lam gyi nus pa*). Some of the drugs employed in medicine are for example gathered in sacred areas during pilgrimages. It is interesting to note that this type of power is transferred through the prayers of the faithful directly to the substance, which retains memory of it for long time. It can therefore be stated that drugs originating from sacred places or possessing a symbolic value are often conferred a supreme quality, *mchog*. This term is associated with the name of the substance in order to differentiate it from the other varieties and to emphasise drugs general properties, as for *dung mchog,* the conch of superior quality or *khab len mchog,* the superior magnetite. However, it is important to observe that consequently to the value of these medicinal substances, many of them would rarely be employed by practitioners. In some cases, practitioners have only read in the medical texts or learnt through legends about high-quality substances but are compelled to employ ordinary drugs or those that are available in their area.

MEDICINAL SUBSTANCE EXPLOITATION

A general outlook of the exploitation carried out by traditional doctors shows that the process should be carried on by following defined models and through specific gathering procedures. A list of general information and rules that concern the exploitation of medicinal substances is mentioned in traditional texts of *materia medica* and seems to be taken into consideration by practitioners. Although the Tibetan pharmacopoeia includes different types of substances such as plants, minerals and animal substances, drug exploitation mostly focuses on the plant kingdom. As I have already reported, medicinal plants occupy an important position in the Tibetan *materia medica*, since they represent at least two thirds of it and are generally the main ingredient of remedies. The exploitation procedure that concerns medicinal plants is therefore crucial for the medicament production, however, it can also be helpful for the exploitation of other medicinal substances because it is in general the more detailed. Some of these procedures are reported in traditional Tibetan texts of *materia medica* and are taught by masters together with other information directly to the students. Theoretical instructions concerning the way medicinal plants have to be gathered and processed are for example shown in the main text of Tibetan medicine, the *rGyud bzhi* (g.Yu thog yon tan mgon po, 1992: 604-608), which also includes some practical advice. Some of this information is reported in the section entitled "the way to mix medicinal herbaceous plants" (*sngo sbyor gyi sde tshan*), which also includes general methods of detoxification and of processing drugs. Although text information are considered by practitioners a general useful guideline, field research shows that the different phases of the exploitation of medicinal substances may be personalised and are often connected with regional and oral traditions. Medical activities are normally influenced by several factors such as the availability of substances, geography and climate and environmental characteristics, but it is also proved that other collateral aspects related to the practitioner's life standard, to his other occupations, to the economic development of the area may be relevant for the exploitation process too.

As concerns medicinal plants, surveys conducted in different Tibetan regions show that practitioners take into consideration the following general aspects: the spot of growth, the gathering season, the parts collected, the drying method and the stocking systems, and finally, the type of preliminary treatment accomplished before the utilisation. Besides, these evaluations follow those concerning the quality and the property of drugs. In the text below I will start to introduce some of the aspects that are evaluated by doctors during their traditional exploitation, including detailed information and more general considerations on their ordinary activity.

The gathering site

As concerns the environmental features, the analysis of the activities carried out by traditional doctors shows that the description of the spot of growth provides relevant

information on drug identification but also gives account on properties (or essential nature, *ngo bo*) and general qualities. The gathering location is chosen according to a few parameters such as its geographical position (South or North of the country), its orientation and exposure to daylight (a sunny or shadowy place), which themselves depend on the physical features and on the altitude of the site. These aspects will all influence the general properties of drugs and will determine for instance their cold and warm properties. High altitude drugs that grow on northern slopes present properties that are linked to the power of the moon (*zla'i ngo bo*), have a cold nature and are particularly effective in the therapy of warm diseases. On the contrary, warm drugs, which are gathered on southern slopes or at low altitude, have the power of the sun (*nyi gi ngo bo*) and are particularly helpful in the therapy of cold diseases.

As I previously described, the *materia medica* may be selected upon its symbolic and religious value and in particular, according to the importance that is conferred to the site of growth. Information on the site and its general signification, the presence of particular objects such as meditation caves (*sgrub phug*), or for example relating to the fact that saints, spiritual masters (*skyes chen*) or their scholars (*pan grub*) lived there in the past, may be considered by practitioners. Always referring to the environment it is useful to say that mountains are usually considered sacred places, the house of gods and divinities[7] and that therefore, plants growing in altitude are generally considered by the informants of high quality and should be preferred to equivalent species growing at lower altitude.

The condition of the gathering location and several general recommendations on the ecological features constitute other important aspects that have to be evaluated by practitioners and influence their choice. Among them, a very important feature is for instance the cleanliness of the spot. Indeed, the presence in the surroundings of cattle, wild animals or human settlements that may pollute the site are carefully evaluated by doctors. Settings that do not present the required standard ecological characteristics are discarded. Although the ecological aspect seems to be exclusively connected to health rules it is linked to philosophical considerations as well. In fact, the cleanliness of the site is directly associated with the concepts of purity and beauty (both spiritual and physical), which are proper to the Buddhist philosophy and which informants indicate by the expression *gtsang nyams dga'*, "a charming and clean place", when describing a plant location. Geographical and geomorphologic evaluations[8] concerning the layout of natural elements of the environment may sometimes be considered by practitioners during the selection of a gathering site.

Timetable and general features of the gathering activity

Another crucial information for plants exploitation regards the gathering timetable. The plucking season is established according to the availability of plants throughout the Tibetan territories. Medicinal plants that thrive over the plateau present a short vegetative cycle, which varies from two to three months during the summer season. Monsoon precipitations strongly influence the growing season like in the eastern regions of Himalaya, but are less important in the regions situated to the North of the chain, while in the East (Sichuan, Yunnan) the influence is variable.

The high altitude vegetation presents a short and variable blooming period, which lasts only two-three weeks/year and may vary according to local geographical features and to climate. The gathering activity is strictly related to the therapeutic properties (*nus pa,* the potency) of drugs, which are therefore collected at specific moments of the year. Curatives properties are present either in the entire plant or in a single portion, so that a plant could be picked up by the doctors entirely or only in part. For each organ : branches, roots, flowers, leaves, seeds, etc., a gathering time, corresponding to the apex of its development, is fixed. Differently, when the practitioner needs the entire specimen he picks the plant up when it reaches the apex of the vegetative period.

An attentive examination of doctors' programs reveals that for the gathering activity they principally refer to the following features: the stage of development, the morphology, the general aspect and dimensions of plants. The data collected among the doctors[9] show that a generic gathering calendar can be planned considering the following information, which includes times and anatomical parts of plants: roots, branches, stems, should be gathered in late autumn and during the winter season; leaves, latex, buds are gathered during summer; flowers, fruits and seeds, sprouts are collected in late summer; barks and resins are collected in spring. Among the roots I point out *ma nu* (*Inula royleana*), *ra mnye* (*Polygonatum verticillatum*), *nye shing* (*Asparagus filicinus*); among stems and branches *sle tres* (*Tinospora cordifolia*) or *tsan dan dkar po* (*Santalum album*); among flowers *se ba* (*Rosa macrophylla*) and *utpal* (*Meconopsis* spp.); among fruits are *se 'bru* (*Punica granatum*) and *'u su* (*Carum carvi*).

It is significant at present to report general information, which refers to the entire process of exploitation carried out by traditional doctors and this will help us understand the way it is managed. Although the collecting procedures pointed out by the informants are mainly conformed to those found in traditional texts the latter are in their majority theoretical. Practitioners therefore adapt this information to their practical occupations. As the data report, personalization of the procedures is for example carried out in accordance with religious faith, education, experience, economical possibilities, practical necessities of practitioners. In addition, differences between the procedures adopted by traditional doctors may exist accord-

[7] I point out among them the well-known divinities of the territory *yul lha, gzhi bdag* and *sa bdag*.
[8] These evaluations are comparable with the ones of the Feng Shui discipline.
[9] A generic calendar of collection is also reported in the *rGyud bzhi*. As I previously showed, gathering periods are divided into four, everyone refers to a different plant organ.

ing to their living place. Practitioners adopt the harvesting timetable previously reported only as a general indication. Yet, they often modify it according to the geographical and climatic characteristics of the region and to the variability of vegetative cycles.

Another factor which may influence the gathering time of a plant is the way of employing it in therapeutics. Along the year, drug properties evolve in relation to the fluctuation of the five cosmic elements (Earth, Water, Fire, Wind and Space). Practitioners are able to produce a specific therapeutic effect by picking up plants at specific periods of the year in accordance with the fundamental elements. As concerns *dur byid* (*Euphorbia stracheyi, Euphorbia hypericifolia*), the latex of the plant is gathered during the summer season and employed to cure all kinds of sickness of the marrow (*rkang*) and of the six empty organs (*snod drug*)[10]. Differently, when the latex of the plant is employed to purify the organism (in a form of a purgative, *bshal ba*), it will be gathered during autumn and winter. By collecting the latex in this period of the year, the downwards movement of the elements Earth and Water inside the plant will support the purgative activity in the body. In the case of *spyang tsher* (*Morina longifolia*) and *ri sho* (*Ligularia virgaurea*), the gathering period and the part collected are variable, according to the specific utilisation of the plant. Employing them as emetics (*skyugs*), spring is advantageous for the collection of both, the whole plant being gathered in the case of *ri sho* and the root for *spyang tsher*. At this time of the year, the cosmic elements Water and Fire prevail in nature and support the emetic action by an upwards movement. However, as I reported above, the best period to pick up underground organs is properly the winter. It can be assumed more in general that a plant organ may be gathered at a different moment of the year according to the therapeutic effect required.

It is also interesting to point out that, as previously shown, the activity of traditional doctors may be influenced by religious beliefs. This is particularly evident during the gathering field trips, whose schedule may be arranged in accordance with religious and astrological events. Relevant dates and commemorations, as the Medicine Buddha's birthday (the 5th of June), the day of the enlightenment of the historical Buddha (the 15th of February), full moon days (*zla ba yar ngo'i dus*), are considered favourable days to collect plants because their therapeutic power increases. As reported by the informants, gathering trips may be scheduled according to the Kalachakra Tantra[11] or to information reported in religious texts or in the annual Tibetan almanac. In addition, to provide detailed astro-medical reports three distinct systems may be considered: the *nag rtsis*, the *dkar rtsis* and the *dbyangs 'char*. These systems utilise a secret tantric practice and different types of calculations, which relate to the position of stars and planets (astronomical calculations) and western-like astrological calculations. In some circumstances, as before preparing a particular remedy, the doctor may carry out several calculations about the patient in order to forecast the results of the therapy. Some practitioners take into great consideration the aspects that are connected with religion and symbolism believing that they significantly influence their general activity and in particular the gathering process. However, nowadays only few learned informants follow the above rules, while most doctors seldom apply them.

Gatherers should conform both to a spiritual and to a physical behaviour. The night before the harvesting a special ceremony may be performed in order to attain a positive attitude, to propitiate divinities and to promote a favourable trip. During the field activity, helpers and apprentices should wear clean clothes, behave politely and respectfully and be in the good mood all along. Formally the attitude of the gatherers must conform to the permanent state of the four noble virtues: love, compassion, joy, equanimity that are considered in fact the main merits of a doctor. At different moments of the gathering special mantras may be addressed to territory divinities to ensure their benevolence together with magic formulas (*sngags*) and ordinary mantras. The mystic mantra of the interdependence of phenomena (*gzungs sngags rten 'brel snying po*) should be for instance continuously recited by practitioners.

Identification, selection and treatment of medicinal drugs

When the collection of medicinal plants starts, Tibetan doctors have to follow a specific procedure and be aware of several recommendations. A key step is the identification of the specimens. During previous surveys in the neighbourhoods of his village the practitioner selects the most interesting spots for the gathering of medicinal plants. Once an area is determined, gatherers generally focus their attention only on a few types of drugs (two or three) and start the selection of similar plant groups. Plant identification is firstly conducted through the observation of its general features, and secondly through the examination of minute morphology, of organ dimensions, colour and quality. Moreover, a plant or a part of it may be picked up and tested through its smell and taste. When all these parameters conform with the ones expected (according to the doctor's education and experience) the specimen is chosen. Although plant taste represents the most important parameter for the attribution of curative properties, smell may be crucial as well. In some cases it is seen as a condition required to establish the good quality of a plant. For example, *Nardostachys grandiflora* (*spang spos*) is a plant that possesses provided with a peculiar fragrance and, according to the informants, should not be picked up when this is absent.

[10] The six empty organs correspond in Tibetan medicine to the intestines, stomach, bile, urinary bladder, seminal fluids.
[11] The Shri Kalachakra is the main astronomical Tibetan text which was translated in Tibetan language from Sanskrit in 1027 A.D. The text is strictly related to the medical practice and presents similarities with the *rGyud bzhi*.

Fig. 2 - A traditional doctor during the collection of medicinal plants in Sichuan (P.R.C.). The identification of a sample of *Nardostachys grandiflora* and the analysis of its general quality throughout visual, gustative and olfactory methods.

Field investigations provide evidence that sometimes plant features reported in the texts of *materia medica*, such as taste, do not necessarily coincide with those of the specimens identified by the doctors in different regions with the same Tibetan name. This can be explained both because of common identification problems[12] and also because according to drug availability practitioners living in different areas are sometimes compelled to select different medicinal plants for the same medical purpose.

When the gathering process is over, specimens are brought back to the doctor's clinic where they are rapidly processed in order to preserve their potency intact. During the following days drugs will undergo several treatments that may be general and also specific: washing, cleaning, cutting, drying, etc. As far as herbs and slender vegetation are concerned, the treatment is generally simple and consists in cleaning and checking the presence of insects and discard damaged and rotten parts. Shrubs and non-herbaceous plants sometimes require a particular treatment of wood, as for *Berberis aristata* (*skyer pa*). In this case, the bark is isolated[13] and thorns removed because both are considered toxic. At first, underground organs are accurately brushed and washed to remove earth deposits and then, conformably to their size, cut into several segments and dried. The cutting is required when a drug or a single part present significant dimensions such as in the case of the underground organ of *ru rta* (*Saussurea yakla* and *Jurinea souliei*), a type of plant frequently used by traditional doctors. The root has in fact to be cut into a few circular segments approximately 1 cm wide to get rapidly dry.

The drying process is carried out in the open or inside houses and may take place in the sun or in the shadow according to plant intrinsic properties (hot or cold) and to how they will be employed. Drugs are spread over a blanket or a tissue and, in a few cases, directly on the floor. The process may lasts several days during which their position is often changed and the evolution of the drying is periodically checked out by doctors. To dry drugs faster, in the past some doctors used to employ a traditional apparatus consisting in a wooden structure similar to a bed presenting an iron grid where plants were scattered. This structure facilitated the drying process by creating an aerated *milieu* and preventing drugs from decaying. Nowadays this method is seldom used. The drying location is chosen taking drugs characteristics and potencies into consideration. When a plant presents a hot potency and is employed in therapeutics to cure cold diseases it should be dried directly in the sun in order to exalt its natural power. That is the case of *thar nu* (*Euphorbia* spp.). Differently, to preserve the potency of a plant as *khur mang* (*Taraxacum officinale* s.l.) that has a cold power and is employed against hot diseases (in the form of a cold medicine), this should be dried mainly in the shade. Once dried, drugs are often mixed up with other ingredients and give birth to complex formula and to medicaments, sometimes they are simply stored.

Fig. 3 - A medicinal formula.

As concerns the storage, drug properties are preserved through few simple rules. Medicinal substances must be stocked in a dry and cool room and protected from the light; to preserve drug fragrance and individual potency

[12] Identification problems sometimes occur because traditional texts of *materia medica* mainly record a regional flora (often the author's region). In the case of *Shel phreng* (De'u dmar dge bshes bstan 'dzin phun tshogs, 1994), which is one of the main texts used by practitioners, it describes the typical flora of *Khams* (a Tibetan region located in the eastern part of the Tibetan plateau). Precise identification are also difficult because traditional texts do not provide accurate botanical descriptions of the specimens.

[13] More precisely, the part described corresponds to the phloem.

(*nus pa*) each substance should be isolated from other types. To store them, different kinds of containers may be employed, such as plastic bags, glass jars, jute bags, paper, but traditional leather bags were also made for this purpose. In general, doctors recommend to employ all medicinal substances quite rapidly, although each substance has a different expiry date, which is also related to the way it has been processed (cleaned, dried, stored). Formally, herbaceous plants are rapidly employed by practitioners because of a quick decay. Therapeutic properties of woody plants and trees last for a long time and can therefore be employed all through the gathering year. Moreover, as concerns medicinal stones, salts, earths and some animal substances, such as horns and bones, no specific decaying time is reported and consequently substances can be stocked for years.

To conclude the description of drug exploitation process it is useful to carry out some general observations. The data reported from different regions show that the traditional utilisation of medicinal substances in Tibetan medicine corresponds with a multifaceted form of exploitation. Several important aspects of the Tibetan culture are in fact deeply interconnected with the medical science and consequently to all activities that are linked to it. I previously showed that drug technical information such as therapeutic properties and processing methods as well as other scientific and empirical aspects are taken into consideration by traditional doctors. During the gathering activity practitioners evaluate the general features of the environment, the climate, the availability of drugs and botanical information. However, according to the traditional medical knowledge, the exploitation of medicinal substances is also carried on through religious and philosophical evaluations and is related to the cosmogonic theory and to its forces. All these factors are linked with drug natural properties. I will also point out a key aspect of the entire process carried on by the doctors: the way the potency (*nus pa*) of substances is preserved throughout the process. In every phase of the exploitation, from the gathering to the processing and the final production of medicaments, practitioners agree on the crucial importance of maintaining therapeutic properties of the *materia medica* intact.

OTHER FORMS OF SUPPLY: THE MARKETS

As I have already reported in a previous section medicinal substances used in Tibetan medicine are nowadays either gathered by the doctors or purchased. Inside the territory of the P.R.C. medicinal drug markets are numerous. Small ones are located in several county villages and at least one important market generally takes place in the province capital. All over Tibetan regions two renowned markets are the one of Lhasa and the one of Chengdu, which are considered the most important in extension, number and quality of substances provided. Practitioners are often compelled to visit big marketplaces once or twice a year to acquire medicinal substances that are not available in the surrounding areas of their village. Outside proper Tibet, two major drug markets are the one in Kathmandu (Nepal) and the one in Delhi (India). Both are visited by traditional doctors and traders coming from different regions and speaking all kinds of languages and dialects. Also merchants coming from the Tibetan border and sometimes from inner Tibet regularly visit them. During the acquisition of drugs a basic step consists in their identification. In each region medicinal substances are usually designated only by local names and sometimes by the corresponding Indian, Nepali, Chinese name. In Nepal and India, market dealers are frequently able to designate the merchandise with different appellations, including Tibetan names of drugs; instead, I could not observe the same habit among dealers of the P.R.C. I have noticed that to select drugs Tibetan doctors sometimes carry along modern texts of Tibetan *materia medica* as a general reference, some of which present lists of drug names in several languages (mainly Tibetan, Chinese and Latin) and helpful illustrations as well.

Fig. 4 - *Moschus chrysogaster*, Solu Khumbu, Nepal.

During the drug selection process several aspects are evaluated by practitioners. The general quality of drugs and their cost are among them. As concerns the cost it usually varies according to the season and to the offer and demand. To report a case: *dbyar rtswa dgun 'bu* (*Cordyceps sinensis*) is a parasitic fungus that is renowned in all south East Asia for its aphrodisiac properties and is included in the Tibetan *materia medica*. According to local offer and to its international value its price may fluctuate from 200 Renminbi to 5,000 Renminbi/ 500 grams (Boesi, 2003). Rare drugs and substances whose trading is limited are normally among the most expensive goods.

The quality assessment and its importance for Tibetan doctors have been discussed above in this paper, some of the parameters used to describe the *materia medica* have been reported. However, for a few medicinal substances, such as some animal organs and minerals, the quality evaluation will also regard their authenticity, due to the

fact that some may be counterfeited, which jeopardises therapeutic results of medicaments. The musk[14], *gla rtsi,* a medicinal essence which is included in the Tibetan *materia medica* represents a good example. Protected by international laws since 1973,[15] the musk deer has been extensively hunted during the past years in order to trade its produce in Asia as well as in other many countries. This substance in its original container (the musk pod) is at present illegally traded in several Tibetan regions yet fake-specimens are widespread among traders. Synthetic semi-precious stones and minerals are also widely traded all over Himalaya and in China taking the place of the original medicinal stones.

THE DOCTOR'S ORDINARY ACTIVITY AND PRACTICAL PROBLEMS

As shown above, the collection of medicinal substances is a complex task and the availability of drugs represents one of its crucial aspects. As concerns in particular the gathering, several factors are considered by practitioners such as the seasonal calendar, astrological calculations, plant vegetative periods, although other aspects can also be considered. Doctors are compelled to plan their entire activity in advance. According to substance availability, supplying trips are organised in the neighbourhoods of the villages and in different and distant areas. As a matter of fact, several practitioners have to devote time to picking up and processing medicinal plants. Helpers may seasonally be hired and transportation is arranged. In this occasion, ordinary medical occupations, as visiting patients and selling medicines, are temporarily suspended. So far, by analysing the annual business of a generic doctor, I have noticed that it may periodically vary from a profit to a loss. The former is the result of medicament retail and the latter occurs in the phase of acquisition of new drugs.

The cost of medicinal substances represents a relevant aspect for the doctor's activity. As a matter of fact, practitioners will often select drugs that are sold at moderate or low prices, sometimes to the detriment of the general quality of drugs. Availability problems seem to be frequently in connection with high prices of drugs. It happens therefore that expensive or rare substances are sometimes replaced by practitioners with more common ones and generic substitutes are adopted. For a few substances of the *materia medica* several options are sometimes reported in the texts, but therapeutic properties of substitutes are generally inferior to the originals. The existence of a potency disparity between drugs substitutes has also been assessed by informants living in different areas (Cardi, 2004). Referring to a specific case observed in Dhorpatan (Nepal), *Anaphalis triplinervis* var. *intermedia* (*spra g.yung*) can be substituted with another plant of the same genus that is called in Tibetan language *spra ba* (*Anaphalis virgata* and *Anaphalis margaritacea*). To describe a widespread replacement, the wood of *tsan dan dmar po* (*Pterocarpus santalinus*), employed to relieve blood and wind diseases is substituted by *ba sha ka* (*Adhatoda vasica*) and also by *hong len* (*Lagotis yunnanensis*) in accordance with their diffusion. Substitutes are also provided for minerals and animals, as in the case of *bya rgod spos* (*Delphinium brunonianum*), which is considered a cheap alternative of the musk (*gla rtsi*). Doctors describe both substances as similar according to their taste, fragrance and potency.

TRADITIONAL ECOLOGY AND SUSTAINABILITY

As concerns the ecological situation and in particular the consequences of the medical activity on the environment, it is interesting to point out which is the attitude of traditional doctors. Whilst the majority of erudite practitioners are aware of the risk of damaging the environment and seem particularly concerned by its status, occasional gatherers act more unconsciously. According to several traditional doctors from different regions of Nepal and Sichuan (P.R.C.), the environment represents the community wealth and must therefore be preserved. During plant gathering doctors manifest their concern for the environment. The amount and the variety of plants that have to be collected is fixed in accordance with the doctor's program of production and with plant availability in the area. Learned practitioners affirm that the collection should be carried on ensuring the perpetuation of plant life and without modifying the gathering site. More precisely, when a practitioner seeks a single portion of a plant (leaves, flowers, branches, etc.) he must not damage the other organs. As concerns the plant part to collect, the harvest should be selective without being destructive. To accomplish a correct gathering, specimens picked up should be about one third of the total number of plants growing in that place. Religious considerations also support the ecological concern of traditional doctors. Even if plants are not included by Tibetans among living beings (*srog chags*)[16] and are therefore not concerned by the Buddhist concept of compassion, to damage a plant and the environment in general is considered a negative action. As concerns animal substances, their exploitation is even more conditioned by religious beliefs and I have noticed that a general trend is nowadays to substitute them with plants when it is possible.

[14] The musk is a secretion produced by the musk-deer (*Moschus berezowski, M. sifanicus, M. chrysogaster*), which the animal stores in a gland in inguinal position.

[15] The drug was traded for its value in perfumery and in pharmaceutics.

[16] For a detailed description of this statement see Boesi (2004).

THE EVOLUTION OF MEDICAL PRACTICE AND OF THE RESOURCE EXPLOITATION

By analysing the situation of traditional medical activities in different regions I have noticed that they are evolving. Environmental, socio-economic and demographic changes are rapidly modifying traditional medical activities. Transformations can be detected at different levels of the practice and of the general knowledge as well. Regular activities of doctors such as drug exploitation are for example affected by the phenomenon. As far as the gathering of medicinal plants is concerned, the data show that in general, several doctors living in different Tibetan regions are losing this habit. The rapid development of villages and rural areas inhabited by Tibetan populations is provoking a progressive departure of traditional doctors from gathering locations. Therefore, plant surveys are sometimes considered more an expenditure in terms of time and money than a benefit. As I have observed in a few areas, a recent trend consists in running a pharmacy shop separately from the doctor's cabinet. Frequently, a member of his family is in charge of the business when the doctor is absent.

Field data have also shown that only a few doctors that belong to the "old school" are able to identify on the field the *materia medica* and to select specimens according to their quality. As I have personally observed, the majority of new doctors that work in government clinics and dispensaries spread all over India, Nepal and China, lack expertise on the *materia medica* and often ignore basic instructions. This fact seems to be related to a general trend in vogue among medical schools, especially in the P.R.C., which consists in separating medical careers and reducing to three years only the doctor's training.[17] Nevertheless, also erudite practitioners seem to be influenced by environmental and socio-economic restrictions. Among the factors affecting the exploitation of natural resources and modifying the medical practice I point out: regional availability of substances, high costs of market supplies, government policies regulating the activity of private doctors (limiting for example practitioners that do not possess a state licence). A practitioner who wants to progress in his medical activity or simply to maintain it regular is so far compelled to reconsider the medical profession as a real business. As concerns the processing of drugs, it is nowadays carried on by hand or mechanically.

While traditional doctors still proceed with old methods, several modern medical institutes funded by the government and by foreign organizations are instead advanced in the utilisation of different sorts of machineries. Mechanical procedures may be applied to carry on the following phases of medicament production: cleaning, washing, drying, crushing, and grinding. Besides the obvious economic profit for the institute which manufactures and sells the medicines, the mechanization creates some advantages also to the community. Benefits mainly consist in the fabrication of types of medicines whose

Fig. 5 - A traditional independent doctor of the region of Baragaon (Nepal) in his laboratory during the preparation of medicines.

preparation is often precluded to independent doctors as for example in the case of complex and expensive pills (such as *rin chen ril bu,* precious pills). Moreover, the medicaments produced can be more numerous and their variety is increased. Nevertheless, the mechanization of the medicament production introduces new problems such as an increasing request of raw drugs that may cause negative effects on the environment. In addition, modern medical institutes may affect the activity of independent practitioners, who cannot compete with them, in particular as far as the production and selling of medicaments in concerned. I have noticed that traditional doctors living in different areas and who run an independent business are aware of this difficult situation and start to feel the consequences of the medicament industrial production. An outcome is that private doctors renounce to manufacture several of their home-made medicines, preferring to buy them from major centres and then retail them to patients. Another consequence of this phenomenon is that traditional doctors have been losing familiarity with the *materia medica* and with its exploitation methods. Their knowledge and experience may probably not be passed to new generations of doctors. In addition, some medical schools of the P.R.C. are at present involved in a reform that basically consists in a simplification of doctors' education and the separation of medical careers. The result is that modern

[17] The traditional medical training lasted from 5 to 7 years. At the end of this training the scholar had to join a period of practical apprenticeships that was conducted in collaboration with a master and was extended for 1 or 2 years further.

Tibetan doctors are basically diagnosticians. A significant outcome of this policy is that many practitioners are professionally incomplete, lack of expertise and are only moderately skilled in the diagnosis. Moreover, a major problem is that doctors are not acquainted with the holistic approach, which is the most important feature of Tibetan medical doctrine, and that they are not able to personalise the therapy.

CONCLUSION

There is no doubt that, being exploited all over Tibet and Himalaya, medicinal substances represent an important resource for Tibetan populations that live in these regions. Trade and medical activities provide evidence of how these resources can be utilised, however an indiscriminate exploitation of medicinal substances may also represent a serious threat. The data reported from several Tibetan regions show that in the past decades some plant and animal species have been overexploited and that their survival has been jeopardised. A few laws and directives have been passed to contrast this situation and protect the environment: new species are continuously introduced in the red lists of the substances traded (CITES, 2005), reforestation programs are set up and medicinal plant nurseries are planned.[18] It is also important to notice that a critical situation of the environment does not represent a serious threat only to the ecology of these regions, but a more immediate threat to the livelihood of Tibetan communities. The ecological stability represents an essential aspect for the survival of Tibetan culture because traditional activities such as medicine are strictly related to the environment and would be rapidly compromised by an indiscriminate and enduring exploitation of the resources. In spite of the fact that all over Tibetan regions medical practice has represented for centuries a sustainable activity, this equilibrium is at present jeopardised by global changes, which include socio-economic and demographic phenomena. Existing programs focusing on biodiversity and conservation of the environment represent a concrete attempt, but not enough has been done to coordinate them with local culture and traditional activities. Broad development plans are sometimes established, like in P.R.C. to pursue an hypothetic model of "modern" civilization where traditional culture has no place. Successful traditional techniques of exploitation are discarded because inappropriate to the economical development strategy of the territory[19], which focuses at present on an industrial system of husbandry and nurseries. Outside T.A.R. territories, specific programs of enterprises in mountain products (animal and plant produces) have been established in Sichuan (Rongsen, 1998) after being already introduced in the Hindu Kush Himalaya (Mohammad, 1989; Quraishi *et al.*, 1993) and in the Nepal Himalaya (Manzardo, 1984; Miller, 1997). Nevertheless, rapid evolution does not allow local people to integrate and even progress, but on the contrary may cause a loss to their culture and a decay in their traditional activities. Recent evolution shows in particular that the activity of independent doctors is among the professions at risk and proves also that the whole medical knowledge is threatened.

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[18] For a few examples of this type of program that relates to the cultivation of medicinal substances see page 20.

[19] Other forms of sustainable traditional activities, such as pastoralism, have been discouraged in the Changtang area (T.A.R.)(Goldstein and Bell,1990)(Fox J.L. *et al.*, 1994).

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Wildlife and plants in traditional and modern Tibet: conceptions, exploitation and conservation
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Plant knowledge among Tibetan populations

Abstract - This article is an ethnographic research into traditional Tibetan plant knowledge and represents the first detailed study of this subject carried out up to now. The plant world is presented from the local Tibetan perspective. The first part is devoted to examining the Tibetan conception of plant and the relationship between plants and other matters. Plant life and vegetation according to Tibetans are also analysed. In the second part, the three aspects of the plant classification process are examined: identification, denomination, and inclusion in a reference system. The last section is devoted to plant exploitation and a comparison between present and past exploitation is presented. Owing to the recent political, cultural, and socio-economic transformations of Tibetan society, there is a serious risk of a definitive loss of the Tibetan botanical knowledge in the near future. This phenomenon has already occurred among several Tibetan communities. The data have been obtained during a research project on ethnobotany and ethnopharmacology of Tibetan speaking populations, undertaken by the author from 1998 to 2002 in different regions of the Tibetan cultural area: the Litang County (Sichuan, China), the region of Baragaon (Mustang District, central Nepal), Khumbu (Solu-Khumbu District, East Nepal) and Dhorpatan (Baglung District, central Nepal).

Riassunto - La conoscenza del mondo vegetale tra le popolazioni tibetane.

Quest'articolo documenta una ricerca etnografica sulle conoscenze botaniche tradizionali dei tibetani e rappresenta il primo studio dettagliato su quest'argomento. Il mondo vegetale è presentato dal punto di vista dei tibetani. Nella prima parte è analizzato il concetto tibetano di vegetale e le relazioni esistenti tra le piante e le altre entità presenti nell'ambiente. Sono esaminate anche la vita delle piante ed i caratteri della vegetazione secondo i tibetani. La seconda parte è dedicata all'analisi dei tre aspetti del processo d'organizzazione della diversità vegetale: identificazione, denominazione e inserimento in un sistema di riferimento. La parte conclusiva è dedicata all'analisi dello sfruttamento dei vegetali confrontando il loro impiego passato e presente. A causa dei recenti mutamenti politici, culturali, e socio-economici, esiste un serio rischio che le conoscenze tradizionali tibetane sul mondo vegetale si estinguano definitivamente entro breve tempo. Questo fenomeno è già stato documentato in alcune comunità tibetane. I dati sono stati raccolti nel corso di un progetto di ricerca sull'etnobotanica e l'etnofarmacologia delle popolazioni di lingua e cultura tibetana, condotto dall'autore tra il 1998 ed il 2002 in diverse regioni tibetane: la Contea di Litang (Sichuan, Cina), le regioni di Baragaon (Distretto di Mustang, Nepal centrale), Khumbu (Distretto di Solu-Khumbu, Nepal orientale) e Dhorpatan (Distretto di Baglung, Nepal centrale).

INTRODUCTION

Before analysing Tibetan plant knowledge, it is essential to show which is the place of plants in the Tibetan perception and classification of natural substances. Although a distinction between the knowledge of educated (chiefly a portion of the clergy and traditional doctors) and non-educated Tibetans has to be made, learned conceptions, except the attribution of the status of "sentient being" to matters, do not influence the general ideas and classification systems of natural objects, which are shared by all Tibetans.

After the introduction of Buddhism in Tibet from the VII century onwards, some Indian philosophical theories shared by all Buddhist traditions arrived in the "land of snows". The elemental theory of the matter and the notion of the "sentient being" are the most important for this subject. The above conceptions are well-known among learned Tibetans. Yet, even if in a less sophisticated way, the distinction between sentient beings and non-sentient beings is also known at the popular level. This conception is crucial in Tibet, since it has a significant impact on human life, in particular as far as the Buddhist principle that does not allow the killing of sentient beings is concerned.

Non-learned criteria that are at the basis of the conception and the classification of natural substances are shared by all Tibetans and are based on both the observation of the natural world and the relationship between man and environment. As Berlin (1992: 9) suggests, "The world of nature cannot be viewed as a continuum from which pieces may be selected ad libitum and organized into arbitrary cultural categories. Rather, groups of plants and animals present themselves to the human observer as series of discontinuities whose structure and content are seen by all human beings in essentially the same way." This latter process is based on perception, mainly visual, of the groups of substances which share similar features (morphological, biological, organization in the space, etc.). These kinds of classifications are instinctively devised, because the same natural substances suggest themselves as separate entities. However, during the fieldwork it came clearly out that natural diversity may be organized in other ways as on the basis of plant cultural importance and use. I will show categories such as medicinal, edible plants, and religious plant offerings.

In short, there are two types of classification, one based on physical perception of reality, the other on cultural\technical impact. These two types of classification should not be considered as independent, but they are

included in a complex system. Tibetans, as most of the populations called "non-modern"[1], do not consider a plant a natural object of its own, as modern scientific classification does, they also see it in reference to the environment, to man and to his activities. That is why plants may be included in categories that are devised on the basis of different criteria at the same time. That is the case of the taxon (category) named *rtswa*[2], "grasses", which is defined by most Tibetans as including the plants having small and narrow leaves growing directly from the soil and which cattle, sheep and goats eat. Ethnobiologists designate these types of categories "complex taxa" (see Friedberg, 1997: 12).

THE OBJECTS OF THE TIBETAN ENVIRONMENT

When Tibetans give a list of natural objects, they usually tend to group together the ones that have similar or identical features. Three main groups may be distinguished: the first includes earths (*sa*), stones (*rdo*), rocks (*brag*), and the minerals extracted from them (*gter*). The second includes woody plants (*shing sdong*), woody climbers (*'khri shing*), grasses (*rtswa*), flowers (*me tog*), and mushrooms (*sha mo*). The third group includes animals (*dud 'gro*) and human beings (*mi*). Several informants (mostly learned people) in different regions employ the same expressions "living beings" (*srog chags*) and "sentient beings" (*sems can*)[3] to connote both men and animals indistinctively. The designation "sentient beings" is the only one used at the popular level.

Among the criteria of classification of natural objects, the distinction between sentient beings and non-sentient beings is very important owing to its influence on the life of Tibetan people. The first group includes all the objects which have a thought process (*sems*) or consciousness (*rnam shes*); the second includes all other kinds of matter that do not have it. As shown above, the beings having a conscious principle are also called *srog chags* (literally: "formed with life"). Hence, a strong connection is seen to exist between the conscious principle (*sems*) and the notion of life (*srog*). The second group has not a name of its own and the informants simply deny the state of "sentient being".

PLANTS

Fieldwork data showed that as in other human populations around the world, the categories occupying the hierarchical rank of "kingdom" are not designated. Ethnobiologists name these groupings, which also occur at other hierarchical levels, "covert categories" (Berlin *et al.*, 1968)[4]. So far, in the common Tibetan language no words as the English terms "plant" and "plant kingdom" are employed. Yet, some recent dictionaries (bKra shis tshe ring & Li'u te cun, 1988: 737; Goldstein, 1986: 328) assign the meaning of "plant" to the terms *rtsi shing* and *sngo rigs*. The expression *rtsi shing* is not used in the ordinary language, being a literary appellation. Traditionally, it only designates fruit trees. The term *sngo rigs*[5] does not point out a plant category, being used to designate the presence of green and tender organs on plants which are either herbaceous or woody. Another term sometimes employed in the same way as *sngo* by common people is *ldum bu*[6]. The dictionary *Tshig mdzod chen mo* (Krang dbyi sun, 1998: 1454) suggests the following definition: "general term equal to *sngo*, which includes all edible and non edible herbaceous plants". In the last decades the use of the expression *skye dngos kyi rigs*, "category of the matter that grows", has been spreading among traditional doctors, owing to the influence of some modern texts of Tibetan pharmacopoeia (see Karma chos 'phel, 1993).

Notwithstanding the absence of a term designating the whole plants, the existence of such a "covert category" may be demonstrated through the evaluation of the common features that, according to the informants, show their constituents. As concerns the categories of grasses (*rtswa*), flowers (*me tog*), woody plants (*shing sdong*), woody climbers (*'khri shing*), and mushrooms (*sha mo*)[7], educated and non-educated informants of various regions describe some differences of morphological, biological and ecological order as well as several common features such as the same "intrinsic nature" (*ngo bo*)[8]: born from the ground, fixed to it by means of underground organs, grow up in the air or in the water. The affinities among these taxa may also be corroborated through the analysis of the terms commonly employed to represent them. As a matter of fact, they are described using a specific similar terminology. Underground organs and stems are constantly designated *rtsa ba* and *sdong po*. Apart from the mushrooms, which exhibit a simple morphology, the terminology employed to point out the different organs of the other categories is the same.

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[1] This is also valid for the societies called "modern", where "non-modern" elements subsist.
[2] Proper Tibetan spellings are given according to the Wylie (1959) system of transliteration (minus the hyphen in between syllables).
[3] Literally: "having a conscious principle".
[4] These taxa may occur at any hierarchical level of ethnobiological classifications.
[5] We point out that in Tibetan medicine the term *sngo* connotes a category of medicinal plants (*sngo sman*), which is worked out on the basis of morphological, biological, and environmental features (Boesi, 2004: 251-258).
[6] The term *ldum* is employed in Tibetan medicine to designate a category of medicinal plants (*ldum sman*) devised as the one of *sngo sman*, mentioned in the above footnote.
[7] These categories, which constitute the "plant forms", will be analysed at the end of the section devoted to classification.
[8] The term *ngo bo* designates the intrinsic features of a thing. It may be a natural object as a tree, an organ of it (the fruits) or a category such as the grasses. It is used mostly by learned Tibetans.

Plants are not living beings

Tibetan people do not consider plants as living beings, because they don't have a conscious principle (*rnam shes*). According to learned informants, death is a process that implies at the same time the cessation of the consciousness and of the faculty of feeling, the interruption of the respiration and the loss of bodily heat. These parameters cannot be described for plant death. As a matter of fact, all Tibetans designate the death of sentient beings by the term *shi ba*, while the death of plants is described by the term "to dry" (*skam po 'gro ba*).

Plant properties and the elemental theory of the matter

Learned informants as monks and traditional doctors explain the different features and qualities of plants and of all types of substances (natural and non-natural) in relation to the elemental theory of the matter, which arrived in Tibet through Buddhism and its related disciplines as medicine (ayurveda) from the VII century onwards. This cosmological theory of Indian origin explains the foundation and the intrinsic nature of any matter of the universe. According to it, all matters are composed of five elements (*'byung ba lnga*): earth (*sa*), water (*chu*), fire (*me*), wind (*rlung*), and space (*nam mkha'*). The five elements are the fundamental constituents of all substances and they are responsible of all their features and qualities. The element earth gives support and firmness, the element water is responsible of aggregation and cohesion, fire generates heat and determines the ripening process, wind generates movement and space allows the growing of all substances. The different features and qualities of each substance are determined by the rate of composition of the five elements. As far as plants are concerned, the scent of a flower, the shape of a leaf, the height of a tree, the curatives properties of a plant or of one of its organs may be explained referring to the elemental theory of the matter. Another important property of the five elements is that they are responsible of all transformation processes occurring in substances. This property is called "action of the five elements" (*'byung ba lnga gi las*).

Plant life

Most Tibetans (educated and non-educated) describe two different types of plant formation: the springing up from the seed and from the roots. The term employed to designate the arising process of all plants is in all cases *skye ba* ("to be born"). According to informants, the majority of the plants propagate producing fruits and seeds. Learned informants affirm that dry fruits (*'bras bu skam po*) at the end of summer and in autumn fall to the ground. The seeds held by fruits have all the potencies (*nus pa*)[9] that allow the development of new plant organs (underground organs, stems, leaves, flowers, etc.). When in early spring ground and air temperature rise, seeds benefit from the heat. They absorb soil humidity and leave their firm (*brtan po*) state. At the beginning, the seed size increases (*sa bon 'phel*), then the underground organ (*rtsa*) starts springing up and eventually the new plant (*myu gu*) grows (*skye*). As concerns the majority of plants, their potencies move upwards during spring and summer and downwards during autumn. In summer, when leaves are fully open, the potencies are concentrated in them. In the same way, they shift to the flowers once they have bloomed. As soon as flowers start withering, the potencies move to the centre of them, where the *ze 'bru* is located. A traditional doctor from Litang (*Li thang*) has affirmed that it contains the "seed of the underground organ" (*rtsa ba'i sa bon*) and that in this portion there is already a principle (*rgyu*)[10] which determines the formation of the underground organs of a new plant. When a fruit has ripened, the potencies are concentrated in it, and later the plant dries (*skam po 'gro*).

Other plants do not completely dry at the onset of winter, but their potencies shift to the underground organs and, as it happens in woody plants (*shing sdong*), also to their stems (*sdong po*). The potencies remain in these organs in a firm state until the next spring without losing their features, being protected by the thick skin (*pags pa*).

Mushrooms don't completely dry because they maintain their potencies in the underground parts and they don't produce fruits and seeds. According to learned informants from Litang, mushrooms usually thrive in wet soil (*sa brlan pa*), but their occurrence is affected by the "necessity of combining factors"[11]. These conditions concern weather and soil features: mushrooms "are born in the soil [when] there are dry dung, wet soil, rain and the proper time."[12]

The process of plant coming up and growing is explained referring to the elemental theory of the matter, which also determines these processes in man and animals. Several learned informants, and in particular a traditional doctor from Khyungpo[13] (*Khyung po*) in east Tibet, have described the role and the task carried out by the five elements in plant transformations. The element earth is crucial to plant existence, because it represents the qualities which give base and solidity to all matters. The element water, absorbed by the plant and by the seed, gives moisture. The element fire gives the heat coming from the sun and affects

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[9] The term "potency" (*nus pa*) points out the action that a substance may originate by means of its features and qualities. In Tibetan medicine this expression designates both particular qualities of medicinal substances, which constitute their therapeutic properties (the eight *nus pa*), and their therapeutic effect. (Boesi, 2004: 48-50).

[10] *rGyu*: "causal factor", "primary cause".

[11] *Cha rkyen 'dzom dgos.*

[12] *Bud shing dang sa brlan pa dang char pa dang dus tshod nges can sa 'og tu skye gi yod red /.*

The term *bud shing* is commonly employed to designate firewood and in particular the small branches gathered to light a fire. Nevertheless, according to our informants of Litang, this term may also be employed in a larger sense to indicate yak dry dung, which is regularly employed as a fuel. The Tibetan-English dictionary Chandra Das (1992: 873) suggests the same meaning.

[13] The region of Khyungpo is located in the eastern part of Tibetan Autonomous Region, in Tengchen (*sTeng chen*) County.

seed warming. The element wind determines all movements and therefore the growth of the plant.

Educated people say that the five elements, and in particular their potencies, also determine plant size. Certain plants, such as fir (*thang shing*[14], *Abies* spp.), have "big growing potencies" (*skye stabs kyi nus pa chen po*), others, as a rhododendron shrub, *sur dkar*[15] (*Rhododendron* spp.) have intermediate (*'bring*) potencies, and others, as most herbaceous plants (*rtswa*) and all mushrooms (*sha mo*), have small (*chung*) potencies. Altitude and temperature are other factors affecting plant size: all informants state that at a low altitude plants usually attain bigger size than at high altitude. A drop in temperature at high altitude causes a decrease of the plant growing process.

The growth and the size attained by certain plants may also be affected by other plants growing near by. These plants constitute mutual helpers and are called "assistants" (*rogs po*). A traditional doctor from Litang has mentioned the plant called *sur nag* (*Rhododendron* sp.). It attains a bigger size only when it benefits of a good soil and when willows (*lcang ma, Salix* sp.) and *tsher ma*[16] shrubs thrive near by.

According to all informants, plants cannot thrive in any environmental setting, but only under fixed conditions related to climate, altitude, exposition, soil, and other factors. In particular, they distinguish sunny sides (*nyin*) and shady sides (*srib*) of the mountains. A plant which grows on one side may quite often not grow on the other. Sunny slopes are warmer and drier and usually allow the growing of less abundant vegetation than shady slopes, which, being colder and wetter, have lush vegetation. According to Litang informants, some plants, such as *mdzo mo sna khrag* (*Androsace strigillosa*) and *mgo re gya re* (*Stellera chamejasme*), need solar heat to grow and are common on sunny slopes, others, as *ut pal sngon po* (*Meconopsis grandis?*) and *dbyar rtswa dgun 'bu*[17] (*Cordyceps sinensis*) are harmed by it and grow on shady slopes. Others, such as *tsher sngon* (*Meconopsis horridula*) may thrive on both the mountainsides. Besides, the distinction may concern plants growing on high and low altitudes (*sa cha mtho po, sa cha dma' po*), on wet and dry soils (*sa cha rlon pa, sa cha skam po*), and on different types of meadows (*spang nag, spang rgod*)[18].

VEGETATION GROUPINGS

Tibetan people living traditionally have a good knowledge of plant distribution in the environment. They describe a few vegetation groupings and several zones having particular features, which are designated through a specific terminology. Sometimes, the presence of certain plants may be evaluated as an essential characteristic of that area. The distinction of these groupings may be also employed as a reference system in the territory.

The most important vegetation groupings are: forests (*shing nags*), meadows (*spang*), and wet meadows (*na*). They are usually described on the basis of the following parameters: dominating plant form, soil features, and characteristics of the plants thriving on it.

Forests (*shing nags*)

The expressions *shing nags* and *nags* (forests) generally designate all types of forests whereas the name *nags chen* (big forests) points out the forests characterised by big woody plants (*shing sdong chen po*). Forests, in particular thick forests (*shing nags mthug po*), mainly thrive in the lower areas called *rong*, which are characterised by deep and narrow valleys (*lung pa chen po*), big rivers (*chu chen po*), snowy mountains (*gangs ri*), good soils (*sa yag po*), warm temperature (*tsha ba*), usually a good amount of precipitation (*char pa mang po*), and the presence of farmers (*zhing pa*). In the Litang County pine (*sgron me shing*) forests, juniper-cypress (*shug pa*) forests, fir (*thang shing*) forests, and oak (*be do*) forests are common in these lower valleys[19].

According to informants of Litang, forests also grow on the *byang thang* ("northern plain"), but the size of woody plants is usually smaller. The term *byang thang* properly designates the high regions (mostly above 4,500 meters) located in north and north-western Tibet, but it is commonly employed to point out all areas of high plateau, characterised by flat valleys covered with grass (*rtswa thang*), where nomads keep their livestock and agriculture is not possible.

Pastoralists of the Litang County also distinguish a type of forest which is spread both at high and low altitude and which consists of many thick small woody plants (*shing sdong chung chung*). According to the local dialect, it is named *nags this* ("forest *this*") or *phu this*[20]. The expression *phu this* (*phu*, "the upper part of a sloping valley") probably indicates that this vegetation grouping grows at high altitude. The informants mention several woody plants, which are shrubs, as *sur nag* (*Rhododendron* sp.) and *sur dkar* (*Rhododendron* sp.), *spen nag* (*Dasiphora fruticosa*), *shug pa* (*Juniperus* sp., *Cupressus* sp.), *mdzo mo shing* (*Caragana erinacea*), *khyi shing* (*Lonicera thibetica*), and *tshar leb* (*Cotoneaster* sp.). Tsampa Nawan (*gTsang pa*

[14] The designation *thang shing* also corresponds to *Pinus* in central Tibet and in some Tibetan regions of Nepal.
[15] The term *sur dkar* ("white *sur*") is commonly employed in east Tibet to designate a type of *sur ru* with aromatic white flowers, which corresponds to a species of *Rhododendron*. I point out that in central Tibet and Nepal the name *ba lu dkar po* ("white *ba lu*") is employed.
[16] According to the informant, the term *tsher ma* designates a woody thorny plant, which I did not observe on the field.
[17] *Cordyceps sinensis* is, according to modern science, an entomophagous fungus parasitizing the larvae of a moth of the genus *Thitarodes*. Differently, Tibetan people regard it as a plant. In particular, they perceive the *dbyar rtswa dgun 'bu* ("summer grass-winter worm") as a single substance, which during winter lives as a worm (*'bu*) and that, after undergoing a metamorphosis on passing from spring to summer, changes into a kind of grass (*rtswa*) (Boesi, 2003: 32).
[18] See the next paragraph for an explanation of the terms *spang nag* and *spang sgo*.
[19] The so-called *rong* areas correspond to the lower valleys mostly located below 3,500 metres, which are quite common in south and east Tibet.
[20] Both the transliterations are given according to my informants.

ngag dbang), a traditional doctor from Baragaon (central Nepal), names *nags phran* ("little forests") the forests characterised by low woody plants.

Meadows (*spang*)

Tibetan people regard meadows as fundamental because they represent the most important source of energy, which allows them to carry out most activities. Meadows are crucial for cattle, sheep, and goat breeding; several plants growing on them are employed as medicine and food, others are sold on local markets or have a cultural value; turf is used to build houses and fences.

The term *spang* ("meadows", "grassland") is a general expression designating all types of meadows, usually dominated by grasses (*rtswa*) and with a fluctuating number of flowers (*me tog*). Its soil is black in colour (*sa nag po*). Many informants in different regions distinguish two types of *spang*: the former is called *spang nag* ("black meadows", "dark[1] meadows"). At Litang the designation *sngo nag* ("dark herbaceous vegetation") is also employed. Sometimes, the term *spang* implicitly refers to *spang nag*. This type of *spang* has the following features: good soft (*mnyen po*) soil, abundant lush grass (*rtswa*) and many flowering herbaceous plants (*me tog*). It is mostly spread at lower altitude (*sa cha dma' po*) and it grows irregularly over high plateaus (*byang thang*). Some of the plants that commonly thrive on dark meadows near Litang town are, according to informants, *tsher sngon* (*Meconopsis horridula*), *lug mig* (*Aster flaccidus*), *khu yug me tog* (*Iris goniocarpa*), *ut pal ser po* (*Meconopsis integrifolia*), *ram bu* (*Polygonum viviparum*), *snya lo* (*Polygonum polystachyum*), *zla ba me tog* (*Ajuga lupulina*) (Fig. 1), and *chu ma rtsi rgod pa* (*Rheum pumilum*).

The latter type of meadow is called *spang rgod* ("wild meadow"). It is very diffused over high plateaus and in particular on the mountains called *spang ri* ("meadow mountains"), rolling hills entirely covered with herbaceous vegetation, which are very common in east Tibet. The soil of wild meadows is hard (*sra mo*), grass is low and not many flowers grow there. Litang informants regard *bskal bzang me tog* (*Androsace thibetica*), *lug ru dmar po* (*Pedicularis przewalskii*) (Fig. 2), and *rta lpags* (*Lamiophlomis rotata*), as plants frequently growing in these areas.

Wet meadows (*na*)

Wet meadows are characterised by wet soil often soaked with water, and by herbaceous vegetation including abundant grass and many flowering herbaceous plants, defined by traditional doctors of Litang as "herbaceous plants of water" (*chu gi rtswa*)[2]. So, the term *na* may be translated as "wet meadows". Traditional doctors of Litang also affirm that the "essential nature" (*ngo bo*) of the plants growing in these areas is smooth (*'jam po*) and flexible (*mnyen po*). *Lug ru ser po* (*Pedicularis longiflora* var. *tubiformis*), *lug ru dmar po*[3] (*P. siphonanta*), *chu skyogs me tog* (*Primula sikkimensis*), *ser chung me tog* (*Caltha scaposa*) (called *rta rmig* by traditional doctors), and *chu skyur* (*Rheum alexandrae*) are some of the plants which are diffused in these areas. Wet meadows may exhibit a flat or a very irregular ground, characterised by many small humps called *na thog* ("top of *na*"). Among these hummocks there stand small pools called *na chu* ("water of *na*").

Fig. 1 - *Zla ba me tog*, *Ajuga lupulina* Maxim., Batang County (Sichuan, China), 4,150 m, near Yidun, May 2000.

Fig. 2 - *Lug ru dmar po*, *Pedicularis przewalskii* Maxim., Litang County (Sichuan, China), 4,100 m, near *gNam sres* mountain, June 1999.

[1] The meaning of *nag* refers in this case to the dark green colour which characterises the vegetation of this type of meadow.
[2] I point out that, according to traditional doctors, the meaning of the term *rtswa* is "herbaceous plants" and not only "grass".
[3] Two types of *lug ru mar po* thrive in Litang: one on "wild meadows" (*spang rgod*) and the other on "wet meadows" (*na*).

THE ORGANIZATION OF PLANT DIVERSITY

In the so-called "traditional societies" there is no deliberate will of classifying natural objects, as in the case of modern scientific classification. So far, I point out that informants do not have any interest in describing a classification system in its entirety, which is a task of ethnobiologists. Ethnobiological classifications arise from the necessity of recording and managing the natural diversity of the environment where populations live. Their aim is to devise an organization, which is suitable to the different activities and situations characterising human life. Among Tibetan people, as among all human communities, the classification process of natural objects is based on the recognition of similarity and differences, which often refer not only to morphology, but also to other plant features such as its environment of growth, its taste and smell, and its practical and cultural value.

The classification process may be divided into three different phases, which are strictly related, and whose temporal succession is flexible: identification, denomination, and inclusion in a reference system (Friedberg, 1986).

Identification

Plant identification systems in human societies have been analysed by several scholars. These studies have shown that human populations basically employ two distinct systems of plant identification: the first one is called "prototypical", the second "componential-conceptual" (Friedberg, 1986).

The prototypical system, based on criteria of similarity, allows the observer to recognize the plant and to give it a name after the observation of its general features, by employing an ideal model which evokes and supports the denomination. I point out that the ideal model is based on the experience, region of origin and education of the observer and constitutes the most typical specimen of the class.

The second system, the so-called componential-conceptual one, is based on the evaluation of the presence of one or several characteristics, which represent the necessary condition to recognize the plant. Therefore, this identification process implies the attentive analysis of specific features of the plant in order to recognize it.

The prototypical system is usually the first one to be employed; the two systems may be used at the same time or in rapid succession. Field observations have shown that Tibetan people, in spite of their education, employ both the prototypical and the componential-conceptual system in plant identification. The prototypical process is usually the first one to be used and the observer often recognizes the plant without a deliberate examination of it. As concerns the componential-conceptual system, only after attentively examining the plant for some time, the informant is able to recognise and name it. The minute observation of plant organs allows the observer to designate it with its complete name, whilst the prototypical system may not be sufficient for a complete identification, allowing him only to determine the basic name without its determinant. Certain plant features are examined more and more into detail and may be employed as identification parameters at different hierarchical levels. E.g., the examination of flower morphology enables traditional doctors to distinguish the plants included in the taxon *me tog glang sna* (*Pedicularis* spp.) from those included in the taxon *lug ru* (*Pedicularis* spp.). As concerns *me tog glang sna*, the observation of the minute features of the flower is the fundamental criterion to distinguish the different varieties of it. The flower of *Pedicularis*[24] has a corolla, which is two-lipped. The upper lip is hooded and often prolonged into a beak, which may be slightly circular or trunk shaped. Traditional doctors of the Litang County and other Tibetan areas identify all species belonging to the genus *Pedicularis* in the same way, firstly employing the prototypical system, and secondly the componential-conceptual system. After a rapid evaluation of the general aspect of the plant, they proceed in its identification examining attentively the morphology of the flower, and in particular its beak, which may be called horn (*rwa*, *ru*), or nose (*sna*), according to its shape. When the beak is slightly circular, it is called horn, and the plant is identified as *lug ru*, "sheep's horn": the beak of the flower is associated with the horn of a sheep. When the beak of the flower doesn't bend on one side, but it bends directly forward, it looks like an elephant's trunk, according to practitioners, and the plant is included in another group called *glang sna*, whose meaning is "elephant's trunk". Traditional doctors recognise different types of *glang sna* (Fig. 3) according to morphological variations in flower size and position, and leaf position.

Fig. 3 - *Glang sna ser po*, *Pedicularis scullyana* Prain ex Maxim., Mustang District (central Nepal), 4,360 m, near Jarkot, August 2001.

[24] *Pedicularis* (lousewort) is an important genus of semi-parasitic plants, often conspicuous in the alpine zone all over the Tibetan plateau and the Himalayan Mountains.

The componential-conceptual identification procedure takes usually place as follows: the informant lays a hand on or pick a flower, a small branch or the entire plant and carefully evaluates its morphological features. He may also analyse smell and taste, and observe the environment.

The features examined are considered more or less important for plant identification according to education, profession and plant knowledge. Tibetans as most plant gatherers, plant merchants, and in particular traditional doctors, as well as traditionally living people as nomads, herdsmen, and people of remote areas, carry out the identification process not only through the evaluation of plant morphology, but taking also into account plant taste (Fig. 4), smell, and environment of growth, parameters which are regarded as crucial.

Hairs and thorns are plant features often examined in the identification process. Several plant types, as *shug pa* (*Juniperus* spp., *Cupressus* spp., *Platycladus orientalis*[25]), are recognized according to the presence (*tsher ma can*) or absence of thorns (*tsher ma med pa*). The Sherpas (*Shar pa*) from Khumbu (east Nepal) identify masculine (*pho*) and feminine (*mo*) birch (*stag pa*) types observing bark colour and features. Several plant varieties are identified from the colour of their flowers. E.g., according to most Tibetans, *ba lu* includes two types of plant: the former, *ba lu dkar po* ("white *ba lu*") (*Rhododendron anthopogon*), is recognized from the white colour (and fragrance) of its flower, and the latter, *ba lu nag po* ("black [dark] *ba lu*") (*R. lepidotum*)[26] from the dark colour. According to traditional doctors, *spang rgyan* ("meadow-ornament") includes three types of plant, which are identified mainly by observing their flower colour: deep blue in the *nag po* (black) type, pale-blue in the *sngon po* (blue) one, and whitish in the *dkar po* (white) type. Smell (*dri ma*) and taste (*bro ba*) are among the features allowing the identification of the different types of wild garlic (*sgog pa*). In Litang, the analysis of the taste of the underground part, which has to be sweet, is crucial to the identification of *ram bu rgod pa* (*Polygonum viviparum*), an edible plant. Another feature evaluated in order to confirm the identification is the presence of latex (*'o ma*) and resin (*thang chu*) as found in *thar nu* (*Euphorbia* spp.) and *'o ma me tog* (*Taraxacum officinale* s.l.).

Friedberg (1986), a French ethnobiologist, says: "dans l'identification populaire, le lieu et le milieu où pousse la plante permettent déjà d'effectuer une sélection. Certaines espèces ont des ports si caractéristiques et originaux qu'à partir d'un âge précoce aucun individu de la société ne peut se tromper". Among Tibetan populations, the examination of the environment is also important for plant identification. Educated and non-educated people know very well that certain plants thrive at high altitude (*sa cha mtho po*) while others grow at lower ones (*sa cha dma' po*), that some plants grow on wet ground (*sa cha rlon pa*) whilst others on dry one (*sa cha skam po*).

The distinction between the shady side (*srib*) and the sunny side (*nyin*) of the mountains is fundamental for the identification. In fact, in the Tibetan perception of the

Fig. 4 - A traditional doctor analyses the taste of *'dzin pa zla bral*, *Aconitum gymnandrum* Maxim., Litang County (Sichuan, China), 4,110 m, near *Li thang sBom ra* mountain, July 1999.

environment in general and, in particular, in the identification of the plants, that differentiation is a crucial factor because, as shown in a previous paragraph, it denotes different growing areas, each one with specific characteristics, where only particular plants may grow. Furthermore, the examination of the environment where the plant grows is even more important in Tibetan medicine, because the potency (*nus pa*) of the plant is also dependent upon the orientation of the slope where it grows, sunny or shady, and even upon the altitude. In particular, while the hot (*tsha*) power (*stobs*) of the sun prevails on the sunny slopes, the cold (*bsil*) power of the moon prevails on the shady ones. In the same way, the altitude influences the cold nature or the hot nature of the plant, increasing or decreasing its potency.

Plant nomenclature

Giving a name to an object represents *a priori* a true classification because it enables the observer to isolate it from the others. The designation derives from a cognitive process whose aim (apart from the one of giving a name) is to attribute a special role and value to each object and which represents the first stage of its actual use. As Berlin (1992: 4-5) says: "before human beings can utilize the biological resources of a local environment, they must, first of all, be classified".

Field research shows that most plant names, being they popular or belonging to Tibetan medicine, are devised in the same way, and that the criteria of nomenclature among Tibetans are the same as shown by several scholars (Conklin, 1962; Berlin, 1992; Martin, 1996; Friedberg, 1997) in other human populations.

The analysis of the different names attributed to plants in different Tibetan regions at the popular level and among learned informants[27] has enabled me to discern a few name types. Some plants are designated with the so-

[25] *Platycladus orientalis* is designated as a type (*rigs*) of *shug pa* in Litang and adjacent Counties of Sichuan Province (China).
[26] The identification of the two types of *sur ru* refers here to the region of Dhorpatan (central Nepal).
[27] In Tibetan societies, learned informants mainly include a portion of the clergy and the majority of traditional doctors.

called "basic plant names" whilst others are named with a basic plant name and an "attribute"[28]. Basic plant names may have a meaning or not while attributes always have one. Basic plant names may be simple or compound. In Table 1, the different types of plant names are shown.

Tab. 1 - Types of plant names employed by Tibetan populations.

Name type	Tibetan name
simple basic name	*sne'u*
compound basic name	*tsher sngon*
simple basic name + attribute	*rtsad pho*, "masculine *rtsad*" *rtsad mo*, "feminine *rtsad*"
compound basic name + attribute	*lug ru ser po*, "yellow *lug ru*" *lug ru dmar po*, "red *lug ru*"

Names are given on the basis of the plant general aspect, the morphological features of its organs and other features such as the taste and smell, the characteristics of the environment, the region of origin, the use (technical, in diet and medicine) and the cultural significance. In the same way as in other popular designation systems, the Tibetan system has an adaptable meaning: vernacular names are easy to learn and to remember. The employ of such terminology enables the people who do not use a writing system to reduce the cognitive effort necessary to deal with a large number of plants.

Another common aspect of ethnobiological classifications, which we observed among Tibetans, is that some plants have an exclusive name while others have to share it. As a matter of fact, several similar plants which are easily subject to be designated with the same basic name, may co-exist in the same area. On the contrary, the plants having an exclusive name are usually the only ones thriving in the area, which have distinctive features isolating them from the others. Yet, other plants may bear an exclusive name because of their important role in the life of the population.

Tibetan popular plant nomenclature varies considerably from region to region, from village to village, and among nomads' settlements and all Tibetans are well aware of that. For example, the people of Litang town report that several different dialects are spoken in the area at the same time and that as a consequence each plant may be named in a different way. They mention the dialect of Litang, the one of Kham[29] (*Khams*), the different dialects spoken by the nomads (*'brog skad*), and the official language of Tibet (*bod yig*). Owing to the fact that many people coming from other Tibetan towns such as Garze (*dKar rtse*), Dzogchen (*rDzogs chen*), Derge (*bDe rge*), and Batang (*'Ba'*) settle in Litang during summer, other dialects are spoken and several denominations of the same plant may be recorded. Only a few plants, which are or were very important in the life of Tibetan people such as juniper-cypress (*shug pa*), saffron (*gur kum*)[30], and potentilla (*gro ma*), keep the same name throughout different regions. On the contrary, the majority of traditional doctors employ the standard drug-names, which correspond to the ones mentioned in the official treatises of *materia medica*.

Basic names

Plant basic names may be simple or compound, descriptive or metaphorical; they may have a meaning or not, and they may be devised on the basis of one or more parameters. Some descriptive names are given according to the general aspect and the biological features and transformation processes of the plant or of one of its organs, others are worked out on the basis of plant ecology. All over Tibetan regions a type of himalayan poppy with blue flowers, and which is a thorny plant, is called *tsher sngon* (*Meconopsis horridula*), whose meaning is "thorn blue". A small buttercup with yellow flowers is common in the Litang County[31] as in many other Tibetan regions, its designation has been devised on the basis of the hot taste of its flowers. Two similar names of the above plant are used at the popular level, *kha tsha me tog*, "flower of the hot mouth", and *lce tsha me tog*, "flower of the hot tongue", while a few traditional doctors of Litang also employ the term *sga tsha*, "hot *sga*"[32]. The nomads of the Litang County name dandelions (*Taraxacum officinale* s.l.) *nyin dgun me tog*, "midday flowers", because they are thought

[28] The terms "plant basic name" and "attribute" were firstly proposed by Conklin (1952) and also employed by Friedberg (1990).

[29] Kham is the denomination of a Tibetan region, located in the eastern portion of the Tibetan plateau, which consists of the six high pasture grounds and the four lower valleys (*sgang drug rong bzhi*) of four great rivers: the Salween (*rngul chu*), the Mekong (*rdza chu*), the Yangtse (*'bri chu*), and the Yalung (*nyag chu*).

[30] See the sub-section devoted to "attributes" for the botanical identification of *gur kum*.

[31] In the Litang County this plant corresponds to *Ranunculus affinis* var. *tanguticus*.

[32] The two expressions *kha tsha me tog* and *lce tsha me tog* are also mentioned in the treatises of Tibetan *materia medica* such as the *Shel phreng* (De'u dmar dge bshes bstan 'dzin phun tshogs, 1994).

to bloom mainly in the central hours of the day. In the town of Derge a plant which sometimes grows on the house flat rooftops made of earth is called *khang phug*, "hole in the house" (*Lepidium apetalum*), because its roots penetrate the roof and can be seen on the ceiling inside the building. Several plant basic names relate to the environment of growth: *spang rgyan*, "meadow-ornament" (*Gentiana* spp.), *spang sgo*, "meadow-egg" (a mushroom not identified, gathered in Litang), *spang spos*, "meadow-incense" (*Nardostachys grandiflora*)[33], *skam skye*[34], " born in dry places" (*Pedicularis cranotopha*)[35].

Metaphorical basic names are worked out on the basis of the analogy between the plant or a part of it and other natural or manufactured similar objects such as animals, animals' organs, and common tools. Sometimes, names are given on the basis of tales and legends, many of which have a religious connotation. Metaphorical basic names often include names of domestic and wild animals living in Tibet and abroad. Many types of lousewort (*Pedicularis* spp.) are called, as already shown in a previous paragraph, *lug ru*, "sheep's horn", others *glang sna*[36], "elephant's trunk", according to the features of their flowers. In Litang, an edible mushroom is designated *byi 'u rkang lag*, "small bird feet" (a mushroom not identified), owing to the morphology of its fruiting body. Several metaphorical basic names refer to man-made objects: nomads and villagers of the Litang County designate *srang ga me tog*, "flower of the *srang ga* [coin]", many plants belonging to the botanical genus *Aster*, because the yellow central part of their flowers is similar to a coin (called *srang ga*) once in circulation in Tibet. The nomads of the same region name *khu yug rdza ril*, "clay pot of *khu yug*"[37], an orchid (*Cypripedium machrantum*) whose flower lip is similar to clay pots (*rdza ril*) traditionally employed in the area. Another interesting designation is *'brug mo ja tshags*, "sieve for tea of Drugmo" (*Lilium lophophorum*) (Fig. 5). According to the same nomads, Drugmo, the wife of Gesar (*Ge sar*), the much-celebrated Tibetan epic hero, used the flower of this plant as a sieve for tea. Other basic plant names as *spang spos* (*Nardostachys grandiflora*), "meadow-incense", and *ston ja* (*Potentilla* sp.), "autumn tea", an herbaceous plant once employed in Litang as a substitute of tea and which was gathered in autumn, are related to the human use of the plant.

Plant basic names originating from Sanskrit and Chinese languages often occur in the Tibetan *materia medica* and sometimes at the popular level.

The Sanskrit name of a few plants once imported from India have been given to similar plants typical of Tibet: all Tibetans employ the name *ut pal*, coming from the Sanskrit *utpala*, which designates the blue lotus

Figure 5 - *'Brug mo ja tshags*, *Lilium lophophorum* Franch., Litang County (Sichuan, China), 4,230 m, *bZhag lung*, June 1999.

(*Nymphaea caerulea*) (Beer, 1999: 37), to point out several different types of poppies thriving in Tibetan regions (*Meconopsis* spp.)[38] as *ut pal ser po* (*Meconopsis integrifolia*) and *ut pal sngon po* (*M. grandis*)[39]. In the Tibetan *materia medica* several plants traditionally imported from India and Nepal have maintained their Sanskrit designation as *pi pi ling* (*Piper longum*) (dGa' ba'i rdo rje, 1998: 137), whose Sanskrit appellation is *pippalī*, and *ka ko la* (*Amomum subulatum*) (ibidem: 97), which corresponds to the Sanskrit *kakkōlam*.

As concerns plant basic names of Chinese origin, several of them are employed at the popular level and in the nomenclature of Tibetan medicinal plants. For example, some plants having an economic value for Tibetan people of the Litang County are named with Chinese designations, which are used at the same time as or substitute traditional Tibetan names. Villagers and nomads designate fir (*Abies* spp.) and spruce (*Picea* spp.) as *thang shing*, but another term often used is *sam pa* or *som pa*[40], which derives from the Chinese *song* (pine). This name is probably employed in other regions of east and northeast Tibet as Rockhill (1894: 88) reports. In the same region, the bulbs of a few species of *Fritillaria*, gathered and sold to Chinese traders by Tibetans, are commonly named "pe

[33] Specimens gathered in Litang and Baragaon
[34] Only traditional doctors know this term, which is proper to the *materia medica* of Tibetan medicine. The popular designation is *lug ru ser po*.
[35] Specimen gathered in Litang
[36] Non-educated Tibetans rarely employ this term
[37] In the Litang County the term *khu yug* is employed as a synonym of *khu byug*, the cukoo bird.
[38] In Tibetan medicine, the name *ut pal* may also designate a few types of buttercups (*Ranunculus* spp.) and aster (*Aster* spp.).
[39] The two specimens have been gathered in Litang County.
[40] The well-known Tibetan pharmacopoeia *Shel phreng* (De'u dmar dge bshes bstan 'dzin phun tshogs, 1994: 254) quotes the expression *som thang shing* as a synonym of *thang shing*

mon". Yet, the popular vernacular name for these plants in Litang is *dug* and *dug med*, while the name employed by traditional doctors is *a 'u rtsi*[41]. The term "pe mon", which nowadays has almost substituted the Tibetan designation, comes from the Chinese name *bei mu* (Kun-Ying Yen, 1992: 85).

Attributes

Attributes are adjectives or nouns added to the plant basic name, which have the function of differentiating two or more plants having the same basic name. Sometimes, and in particular in the nomenclature of Tibetan *materia medica*, two attributes are added. In this case, the second one has the function of differentiating two plants having the same basic name and the same first attribute. Attributes are mostly worked out on the basis of the following plant features: colour of the flower, plant size, gender, environment of growth, and region of origin. Metaphorical attributes associating plant morphology to animal morphology also occur. Only in the nomenclature of Tibetan medicinal plants attributes are devised on the basis of plant efficacy.

I have shown in the previous paragraphs several plant basic names having attributes referring to flower colour as *ba lu*, *lug ru*, and *spang rgyan*. The adjectives *chen* (big) and *chung* (small) are used as attributes with the function of differentiating similar plants having a different size. *Ser chen me tog* ("big yellow flower") and *ser chung me tog* ("small yellow flower")[42] are the designations used by villagers of Litang to distinguish two plant types on the basis of their flower size. In the nomenclature of Tibetan *materia medica* the two above attributes are used to distinguish two types of *thar nu*: *thar chen* (*Euphorbia wallichii*), "big *thar nu*" and *thar chung*, "small *thar nu*" (*Euphorbia longifolia*)[43]. The three attributes *pho* (masculine), *mo* (feminine), and *ma ning* (hermaphrodite) occur in plant names both at the popular level and in Tibetan *materia medica*. They are often related to plant size or other general features, to the morphology of their organs, and in many cases to flower[44] size and position. The attribute *pho* often points out the biggest plant type or the one having the biggest flower, whilst the attribute *mo* designates the smallest type or the one having the smallest flower. The attribute *ma ning*, rarely used at the popular level, designates a plant type showing intermediate features between masculine and feminine type. For example, the Sherpa villagers of the Nepalese region of Khumbu use the attributes *pho* and *mo* to differentiate two types of birch (*stag pa*, *Betula utilis*): *mo stag* and *pho stag*. The masculine type has a reddish bark, which is easily stripped off, and a very hard wood, while the feminine type has narrow leaves, a whitish bark which is difficult to strip off, and a wood that is not as hard as in the masculine type.

Animal names sometimes occur as attributes as in the case of *shug pa* (*Juniperus* spp., *Cupressus* spp., *Platycladus orientalis*). The attributes *ra* (goat) and *lug* (sheep) are commonly used in all Tibetan regions to distinguish two types of juniper-cypress on the basis of leaf morphology. The type called *ra shug* has needle-like leaves, which are said to be similar to goats' horns. The type called *lug shug* has scale-like leaves and is related to sheep's horns, which are crescent-shaped. Some attributes are related to the environment of growth of the plant. For example, a traditional doctor from Baragaon says that *mtshe ldum* includes several types: *spang mtshe* (meadow *mtshe*), *brag mtshe* (rock *mtshe*), and *chu mtshe* (water *mtshe*)[45]. Other attributes are connected to the region where the plant typically grows, as with *gur kum*. Educated and non-educated Tibetans in different regions distinguish three types of this plant: *kha che gur kum* (*Crocus sativus*), *bod kyi gur kum* (*Calendula officinalis*), and *bal gyi gur kum* (*Carthamus tinctorius*). Each attribute is probably connected either to the region from where the type of saffron is or was traditionally imported or it may point out a local substitute. As a matter of fact, *kha che gur kum* (*gur kum* of Kashmir) was principally imported from Kashmir, *bal gyi gur kum* (*gur kum* of Nepal) does not thrive in the wild over Tibetan regions, and was imported from nearby areas, in particular, according to a traditional doctor from Khyungpo, it came mostly from Nepal and India. *Bod kyi gur kum* (*gur kum* of Tibet) is probably so named because it is grown in several Tibetan regions in house gardens. Sometimes the name is related to the plant form[46] to which the type belongs as with the sacred plant imported from India called *ku sha* (*Tysanolaena maxima*), which has a Tibetan type called *rtswa ku sha* (grass *ku sha*) among Litang villagers.

Classification

Six hierarchical levels can be pointed out in Tibetan plant classification: variety, type, basic name, set[47], plant forms, and kingdom.

Basic name, type and variety levels

The basic name level, the third one, is the most important in Tibetan and non-Tibetan ethnobiological classifications because it is the starting point to organize plant diversity. At the basic name level, the so-called "series"[48] represent the taxa which I firstly recognized on the field.

[41] According to a modern pharmacopoeia of Tibetan *materia medica* this plant corresponds to *Fritillaria cirrhosa* (dGa' ba'i rdo rje, 1998: 319).
[42] The two so named types of plant usually belong to the following botanical genera: *Trollius*, *Caltha*, and sometimes *Ranunculus*.
[43] The identification of these two Tibetan medicinal plants refers to the region of Dhorpatan (central Nepal).
[44] The meaning of the term flower is the common one, and not the botanical one.
[45] According to dGa' ba'i rdo rje (1998: 269), *brag mtshe* corresponds to *Ephedra equisetina*, *spang mtshe* to *E. gerardiana* and *E. minuta*, *chu mtshe* to *Equisetum diffusum*.
[46] See the sub-section "Plant forms".
[47] Friedberg (1990: 83-87) designates this kind of groupings "ensembles".
[48] Friedberg (1990: 84) proposed the term "séries" to designate these plant groupings.

They may include two or more types having the same basic name and that are categorized by assigning them a specific attribute. Each type may include different varieties. Series usually include similar plants that are classified on the basis of minute morphological variations, as the presence of thorns, leaf shape, bark features, and often on the basis of flower colour and environment of growth. Parameters of classification and identification frequently correspond. The plant cultural significance sometimes has an important role in the categorisation such as with wild garlic (*sgog pa*). Litang villagers differentiate several types of garlic: *byi'u sgog* (*Allium macranthum*), "small bird's garlic"; *rug sgog* (*Allium prattii*), "*rug* garlic", *sha sgog* (*Allium* sp.), "meat garlic"; *sgog pa* (*Allium* sp.), "garlic". This is a complex taxon whose constituents are classified according to parameters of different nature. In particular, the informants affirm that *sha sgog* is the type usually eaten with meat and that *byi'u sgog* has a flower similar to the body of a small bird.

Set level

Other taxa of the next hierarchical order, the fourth one, named "set", include plants having different basic names, that is two or more "series". Sometimes, these categories do not have their own designation and are described by using a circumlocution. In this case, plants belonging to the same set are often pointed out by using the expressions "they go together" (*mnyam du 'gro*) and "they are companions" (*rogs pa red*). Other scholars (Bulmer, 1974: 95; Friedberg, 1990: 86; Berlin, 1992: 145) have provided evidence of the use of these expressions in several ethnobotanical classifications around the world. Sets are devised on the basis of parameters of different nature, which may be employed simultaneously: for example, morphological, biological features and use. Owing to their formation criteria, several of these groupings are juxtaposed as far as their constituents are concerned and they cannot be arranged hierarchically.

Three groups of classification parameters may be differentiated: ecological, morphological-biological, and cultural-technical.

Traditional doctors of Litang classify two plant groups on the basis of their environment of growth and their growing needs. The first one, called *chu gi rtswa* ("herbaceous plants of water"), includes the plants thriving on wet soils (*sa cha rlon pa*) and having tender and flexible organs. The second one, called *sa skam po gi rtswa* ("herbaceous plants of dry soils") includes plants growing on dry grounds and having organs that, once broken, produce a sharp sound.

The same informants separate two groups of herbaceous plants on the basis of the their life cycle. Certain plants, called *grang rtswa* ("cold herbaceous plants"), start growing at the beginning of spring when temperature is still low, whereas others wait until summer has come. The designation *grang rtswa* also points out herbaceous plants whose blooming occurs in autumn. The second group, which includes herbaceous plants completing their life cycle in full summer, is not named. According to Jäschke's Tibetan-English Dictionary (1992: 556), mushrooms may be classified in three categories referring to their environment of growth: *klung sha* (valley mushrooms), *chu sha* (water mushrooms), and *shing sha* (wood mushrooms).

Other sets include a small number of series and mostly represent medicinal plants or plants having an important cultural and technical use. These groupings are not common. Plants included in these sets have similar morphological features and sometimes similar taste and smell[49].

For example, the taxon *shug pa* (Fig. 6) is well known in all Tibetan regions by the entire population. It designates some plants belonging to the botanical genus *Juniperus*, *Cupressus*, and *Platycladus*[50]. The parameters of distinction of the different types recognized by Tibetans are leaf morphology, plant size, environment of growth, and fragrance[51]. Here follows the classification of the taxon *shug pa* in the Tibetan region of Baragaon. This category consists of two series: *shug pa* and *spa ma*, which both are included in the same group owing to their morphological similarities. Yet, they differ as far as the general aspect is concerned: *spa ma* has a flat outlook while *shug pa* has an upright one. *sPa ma* usually thrives at high altitude.

The series *shug pa* includes two types: *rgya shug* and *shug tsher*. *Shug tsher* (*Juniperus indica*), "thorny *shug pa*", is mainly characterized by having thorns[52], whilst the main quality of *rgya shug*, "Indian *shug pa*", is to be smooth (*'jam po*)[53]. Two varieties of *rgya shug* are recognized in Baragaon: *lha shug* ("*shug pa* of gods") (*Cupressus torulosa*), which has a particular fragrance and is used as incense (*spos*), and *lug shug*, "*shug pa* of sheep" (*Juniperus indica*)[54].

Informants from Baragaon differentiate two types of *spa ma*: *spa ma tsher ma chen* ("*spa ma* having thorns") (*Juniperus squamata*), a dwarf-spreading shrub with needle-shaped leaves; and *spa ma tsher ma med pa* ("*spa ma* without thorns"), which I did not observe on the field. A Japanese team which carried out an ethnobotanical field survey in the same region in the 1980s (Kojima, 1986: 59) identified *spa ma tsher ma can* as *Juniperus communis*, which at high altitudes grows as a prostrate shrub. As far as *spa ma tsher ma med pa* is concerned, according to floristic and ecological studies carried out in the area, other species of juniper and cypress, which can be thus named, do not exist. It could be speculated that the old plant specimens of *Juniperus indica* having scale-like leaves and thriving as dwarf-spreading shrubs at high alti-

[49] The majority of these kind of sets include plants belonging to the same genus or, more frequently, to the same botanical family.
[50] These three species belong to the botanical family of Cupressaceae.
[51] The paramaters of distinction used at the popular level and the one used by traditional doctors almost coincide.
[52] *Juniperus indica* has awl-shaped leaves on lower branches and in young plants.
[53] *rGya shug* has scale-like adpressed leaves.
[54] Adult trees, having almost scale-like leaves, are so named.

tudes might be referred to as *spa ma tsher ma med pa*.

This classification is mainly known by learned informants of Baragaon. Many non-educated people do not recognize the taxon *rgya shug* and seldom the taxon *lha shug*. Other informants, both educated and non-educated, use the designations *lha shug, rgya shug*, and *lug shug* to designate all types of *shug pa* which have scale-like leaves.

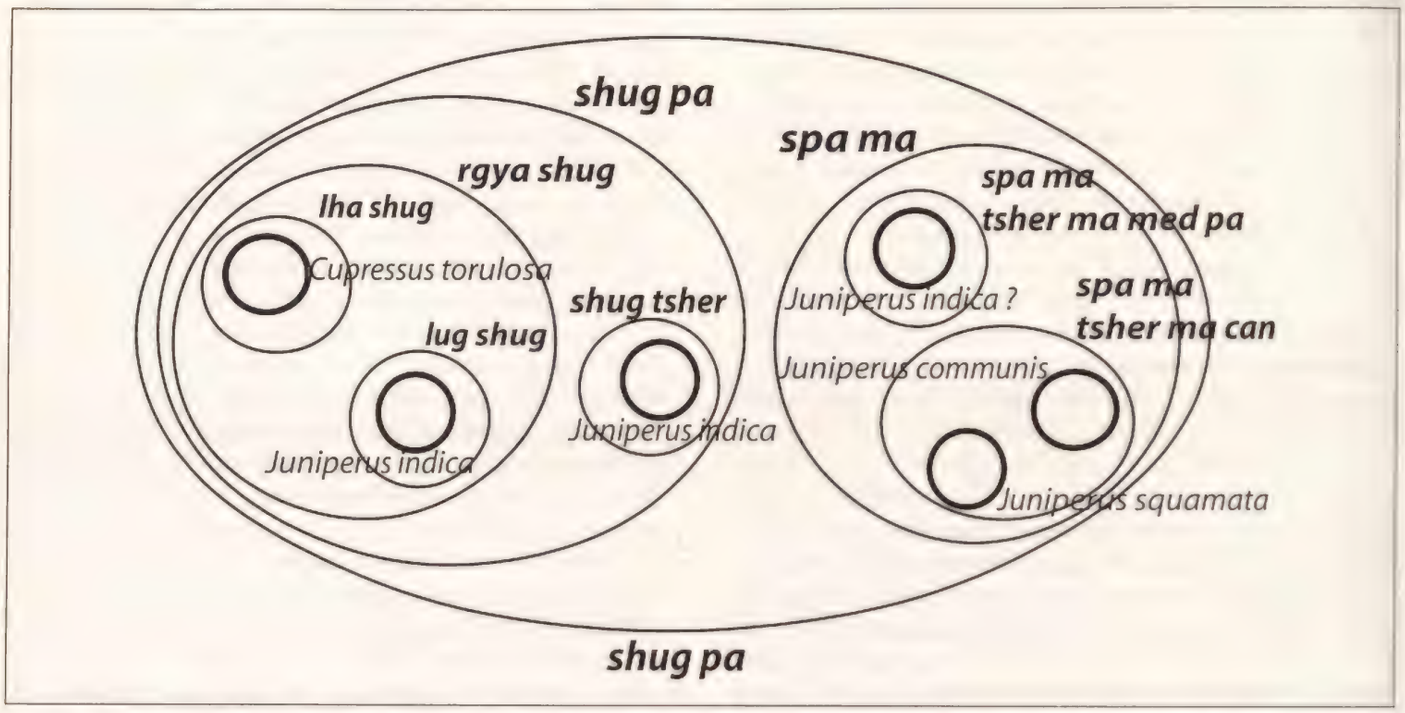

Fig. 6 - The taxon *shug pa* in the region of Baragaon (central Nepal). To show plant categories, I adopted the system employed by Berlin (1992: 47). Biological taxa are represented by circle in bold, ethnobiological taxa are pointed out by thin circle and ellipses, which may include one or more biological species. The designations of ethnobiological taxa are given in bold italics, while the names of biological taxa are given in italics.

Other sets, which occur in all Tibetan regions among educated and non-educated people, are worked out on the basis of other features than plant morphology, biology, and ecology. Their criteria of construction are based on plant technical use and cultural significance and also other natural objects such as mineral and animal extracts may be included in these categories. The groupings as *sngo tshal* (herbaceous edible plants), *spos* (incense), *sman* (medicines), *sman rtswa* (medicinal herbaceous plants), *dug* (poisons), and *me shing* (firewood) are well known by most informants in different Tibetan regions.

Traditional doctors employ a detailed classification of medicinal plants, which is worked out on the basis of several criteria such as morphological features, taste, smell, environment of growth, and therapeutic properties (Boesi, 2004: 239-283; Cardi, 2004: 31-75). At the popular level, most people know a small number of medicinal plants (rarely more than 15), which may be employed to cure some of most common and simple ailments. Only medicinal plant gatherers and traders are able to identify more than a few medicinal plants, but they don't know their classification, therapeutic properties and use.

Edible wild plants, nowadays seldom employed by Tibetans, are commonly named *sngo tshal*, "vegetables". This designation includes also the vegetables that are grown in house gardens.

Some plants are included in the category of poisons (*dug*), which also includes substances of animal and mineral origin. The term *dug* does not only designate toxic substances that cause serious disorders, but also all substances that generate minor effects on the body such as digestive problems. Many edible plants having bitter taste are treated before consumption to eliminate their unpleasant taste, which is commonly referred to as poison and which has no other effects than causing a difficult and slow digestion. Other plants, such as *mgo re gya re* (*Stellera chamaejasme*) in Litang and Baragaon[55], are considered toxic owing to their scent, which may cause bad headache and fainting fits.

Plants having a particular fragrance and that are used as incense both by laymen and monks, are designated as *spos* (incense). This grouping also includes other substances than plants.

Firewood (*me shing*) also represents an important plant category, whose constituents are classified on the basis of two main criteria: heat production and burning rapidity. The people of Litang list the different types of wood locally used according to their decreasing amount of heat production as follows: oak (*be do shing*, *Quercus* sect. *semecarpifolia*), birch (*gro ba shing*[56], *Betula* sp.), juniper and cypress (*shug pa shing*, *Juniperus* sp., *Cupressus* sp.), fir and spruce (*thang shing*, *Abies* sp.,

[55] The popular designation of this plant in Baragaon is *mgo po rol bdang* according to an educated informant.
[56] In many other Tibetan regions the term *stag pa* is used to point out birch.

Picea sp.), and pine (*sgron me shing*, *Pinus* sp.). As concerns burning rapidity, oak wood is the one that burns less rapidly, followed by birch wood, juniper and cypress wood, fir and spruce wood, and eventually pine wood. So far, oak and birch timber is considered the best one as firewood.

Plant forms

Most informants recognize five or four plant forms[57], listed according to two different models.

1) The five plant forms are mushrooms (*sha mo*), grasses (*rtswa*), flowers (*me tog*), woody plants (*shing sdong*), and woody climbers (*'khri shing*)[58].

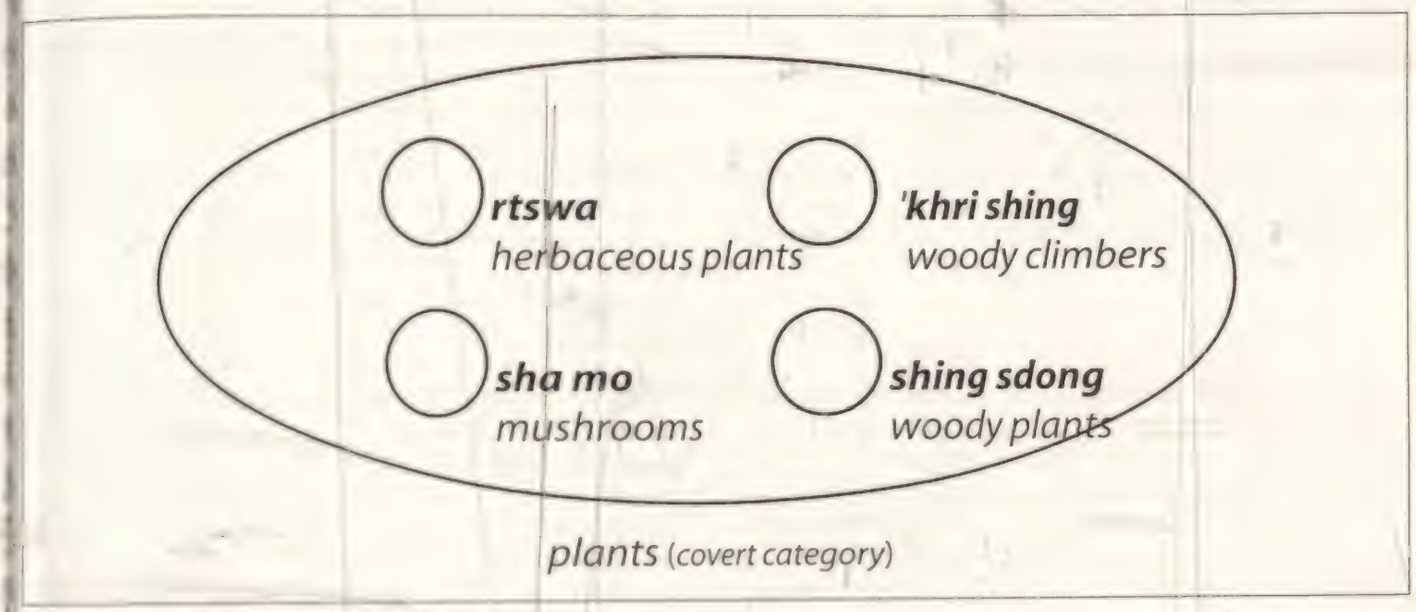

Fig. 7 - First model of classification of plant forms.

2) In the second model plant forms consist of four taxa: mushrooms (*sha mo*), herbaceous plants (*rtswa*), woody plants (*shing sdong*), and woody climbers (*'khri shing*). In this model the categories *rtswa* (herbs) and *me tog* (flowers) of the first model are included in a single taxon named *rtswa*.

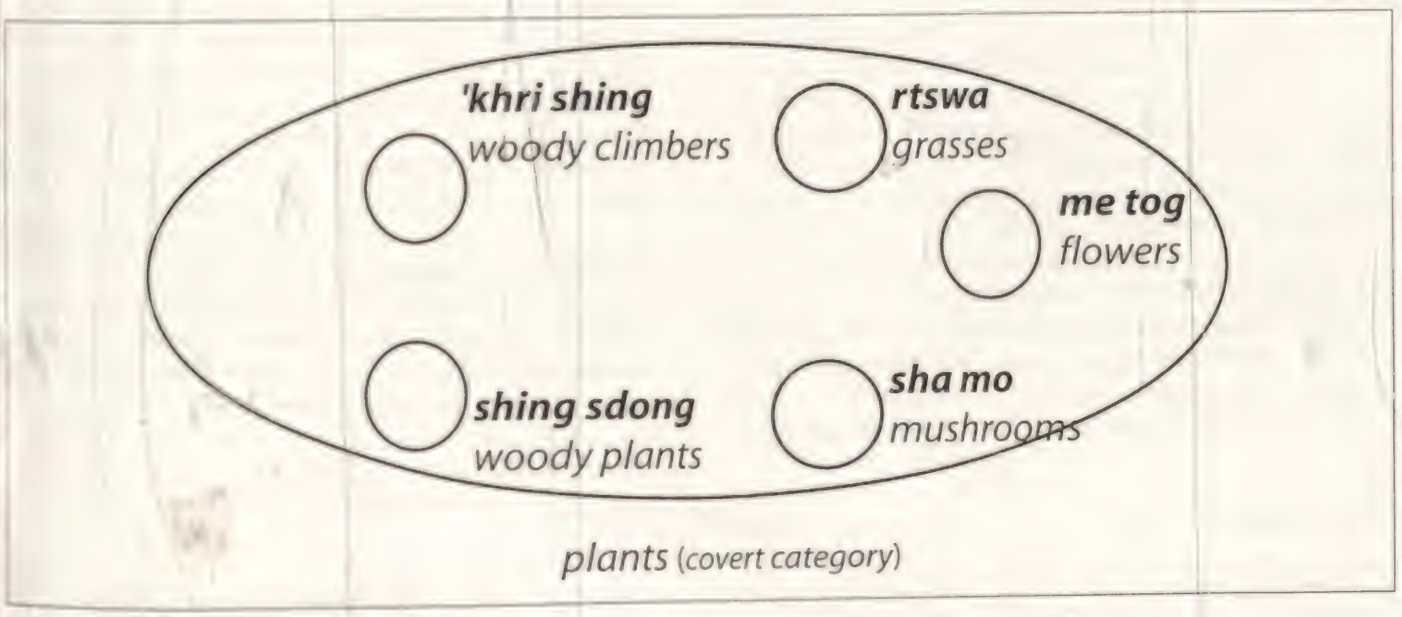

Fig. 8 - Second model of classification of plant forms.

[57] As Berlin (1992: 166-167) reports, "...such broadly inclusive classes generally occur as the first major groupings within each ethnobiological classification kingdom, forming a contrastive group of a small number of taxa of plants and animals...While some groupings correspond rather closely to recognized scientific higher-order taxa, most life-form taxa do not reflect biologically natural classes of organisms. ... In the plant world, the focus of major differences based on stem habit, probably one of the primary perceptual features leading to the recognition of the most common major life-form taxa found in folk systems of ethnobiological classification (e.g. "tree", "vine", "herbaceous plant"), leads to grouping that often violate natural biological taxa at the family level".

[58] The term *'khri shing* may be literally translated as "wood which twines".

The differences between the two above models are not important as far as plant forms general conception and identification of their constituents are concerned. As a matter of fact, many informants from different regions consider both the models valid and employ them indistinctively. Several non-educated informants do not mention the category of woody climbers (*'khri shing*), probably owing to the fact that in Tibetan regions only a limited number of plants can be included in this taxon. A small number of traditional doctors include woody climbers in the category of woody plants (*shing sdong*).

As with the first model, the criterion of distinction between grasses (*rtswa*) and flowers (*me tog*)[59] is the presence or the absence of flowers. Other features are similar in both categories: a few traditional doctors have pointed out that grasses and flowers share the same intrinsic nature of being "herbaceous green tender" (*ngo bo sngo red*). That is why most educated informants, and in particular traditional doctors, have reported the second model of classification. They consider crucial for the classification the essential nature of the constituents of these two groupings and not their morphological variations. So far, they describe only one *taxon* named *rtswa*, which includes all herbaceous plants[60]. Although they exhibit distinct morphological features, mushrooms (*sha mo*) are believed (among traditional doctors) to share the same intrinsic nature named *sngo* of herbaceous plants and flowers as well as, as shown in a previous paragraph, several common features: growth from the soil (*sa nas skye*), soft (*'jam po*) and flexible (*mnyen po*) organs.

PLANT EXPLOITATION

Owing to their importance for yak, sheep, and goat breeding, for firewood (also as yak dung), house construction, and medicine, plants represent a crucial resource for Tibetan populations. Several plant and mushroom species, *dbyar rtswa dgun 'bu* (*Cordyceps sinensis*) (Boesi, 2003; Winkler, 2004) and *spang spos* (*Nardostachys grandiflora*) to name a few, had and have economic importance, and in the past decades several of them have become a significant source of income for Tibetan populations.

Comparing fieldwork observations and recent ethnobotanical publications to information gathered by explorers and missionaries in the past centuries, it clearly came out that certain plants played a more important role in the past, whilst others are more important at the present time. For example, plants were frequently employed as food in particular during famines, tools were manufactured with local wood, and several natural colours were prepared from locally gathered plants and minerals. The situation today is very different: vegetables, many tools and most dyes are imported from lowland regions. The cause of this phenomenon may be related to the socio-economic, cultural and political changes, which have been mainly taking place since the 1950s, after the Chinese take-over of Tibetan regions. New products have arrived in many Tibetan regions and have substituted the old ones. Fieldwork observations in the Litang County are valid also in many other Tibetan cultural regions: villagers having relationship with the main economic centres owing to improved communication and transportation facilities have abandoned the use of wild plants. Yet, the use of plants is relatively spread in remote villages and among several nomadic communities, although the number of plants actually gathered is small. The use of plants as religious offerings in temples and private houses, and in children games is still important among the population of Litang. This use is not so spread in other regions as Ladakh, Baragaon, and Shar Khumbu.

Other plants are nowadays far more important than in the past as economic resource and they sometimes represent the most important source of income for several Tibetan communities. During the last decades, the market demand for well renowned natural substances, many of which coming from the Tibetan regions, utilised in traditional medicines (Chinese, Ayurvedic) and diet, and sought by pharmaceutical and phyto-pharmaceutical companies, has increased. As far as the exploitation of natural produce is concerned, following the recent economic liberalisation, improved transportation and development of markets linked to the international economy, the trading in natural produce gathered in the wild has been skyrocketing. These various kinds of produce, which include many plants, can be bartered or sold for the cash needed to pay taxes or to purchase staple commodities, including food in case of famine.

CONCLUSION

The knowledge of the plant world varies among Tibetans in relation to education, profession (herders, traders, medicinal plant gatherers, traditional doctors, monks, etc.) and to cultural influences coming from other regions (e.g., India and China). According to fieldwork data obtained in different regions and the few ethnobotanical papers on Tibetan populations (e.g. Sacherer, 1979), Tibetan botanical knowledge is homogeneous and the systems of plant identification and classification correspond to the ones observed among other populations around the world.

Owing to the recent political, cultural and socio-eco-

[59] The word *me tog* designates both a flower (common sense) and a herbaceous plant bearing one.

[60] This expression has a large meaning, including not only all herbaceous plants, but also other lower taxa of modern botanical classification such as ferns (pteridophites) and mosses (bryophytes).

nomic changes that have been affecting more or less markedly the entire Tibetan cultural area, Tibetan knowledge of the plant world is endangered as well as all Tibetan traditional lore. For example, in Litang this phenomenon is quite spread. New generations did not receive from their families most of the information on traditional life. As a matter of fact, the majority of young people do not know plant vernacular names and use, whereas old people do. Yet, in the same region, young nomads still have good knowledge of plants and environment.

I point out that the investigation into traditional knowledge related to the environment may be crucial in order to establish natural reserves and to set up programs of natural resource conservation and of sustainable development. So far, the research into Tibetan plant knowledge, as well as in general on Tibetan traditions, should be carried out intensively and rapidly to document and conserve this valuable lore for future generations before it is lost forever.

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Joseph L. Fox and Dawa Tsering

Biodiversity conservation and natural resource exploitation on Tibet's northwest Chang Tang highlands

Abstract - At the northern extent of human habitation on the western Tibetan plateau (ca. 34° N) nomadic pastoralists make a living at elevations around 5,000 m on what is known as the Chang Tang or "northern plains". These nomads herd primarily sheep, cashmere goats, a small number of yaks, and a few horses. This herding occurs amid one of the most spectacular wildlife communities remaining today on the planet. Tens of thousands of Tibetan antelope, Tibetan gazelle, Tibetan wild ass or kiang, blue sheep, and lesser numbers of wild yak and Tibetan argali (sheep) are still present on these high plains and mountains. A dramatic decrease in populations of antelope and wild yak, however, has prompted the government to designate several new nature reserves on the western Tibetan Plateau, including the 300,000 km² Chang Tang Nature Reserve covering most of the Plateau's northwest highlands. Pastoralists use of the region has historically been rather limited, but especially within the past 50 years has been expanding and increasing rapidly in density in many of the northern parts, thus introducing new patterns of rangeland use. But the marginal quality of these high rangelands for livestock production makes the new immigrants more vulnerable than most pastoralists to environmental disasters that kill livestock, thus explaining why one of the primary incentives for settling the northern areas has been the potential for hunting of the wildlife as a survival strategy. A new ban on all hunting in the reserve has compromised this subsistence and income producing alternative, and placed a greater emphasis on the development of livestock husbandry. But the modernisation of livestock production and implementation of new grassland laws in western China may in the long-term be at odds with the conservation goals of the reserve. Amid a backdrop of climate change, a complex history of immigration, government efforts to develop the mineral and pasture resources of the region and both national and global interests in protecting the unique biodiversity, the future of the Chang Tang is highly uncertain. The degree to which the Tibet Autonomous Region creates comprehensive and effective management actions that address long-term issues of rangeland exploitation will in the end determine the success of efforts to achieve the dual goals of enhancing the Chang Tang nomads' standard of living and conserving the area's truly unique array of biodiversity.

Riassunto - Conservazione della biodiversità e sfruttamento delle risorse naturali nelle regione elevate nord occidentali del Chang Tang tibetano. Vicino al limite settentrionale degli insediamenti umani (ca. 34° N) nella parte occidentale dell'altopiano tibetano conosciuta come Chang Tang o "pianure settentrionali", i nomadi tibetani vivono dedicandosi all'allevamento a circa 5000 metri d'altitudine. I nomadi allevano pecore, capre della razza "kashmir", un numero ridotto di yak e cavalli. Quest'attività è svolta in una tra le comunità di fauna selvatica più spettacolari che restano oggi sul pianeta. Decine di migliaia di antilopi tibetane, gazzelle tibetane, asini selvatici tibetani o kiang, pecore azzurre, ed un numero minore di yak selvatici e di argali tibetani, sono ancora presenti su questi altopiani e montagne. Una dimunuzione drammatica delle popolazioni di antilope e di yak selvatico ha tuttavia spinto il governo a creare alcune nuove riserve naturali nella parte occidentale dell'altopiano tibetano, tra cui il Chang Tang Nature Reserve (300,000 km²) che copre la maggior parte delle regioni elevate occidentali dell'altopiano. Lo sfruttamento di queste aree da parte delle popolazioni dedite alla pastorizia (pastoralist) è stato storicamente limitato, ma in particolare negli ultimi 50 anni si è diffusio ed è rapidamente aumentato in molte regioni settentrionali, determinando così nuovi modi d'utilizzazione delle aree montuose. Tuttavia, la scarsa qualità di queste aree montuose per l'allevamento rende i nuovi immigrati più vulnerabili ai disastri ambientali che uccidono il bestiame rispetto alla maggioranza delle comunità di pastori. Si spiega così come uno tra i principali incentivi a stabilirsi nelle regioni settentrionali sia stata la possibilità di cacciare la fauna selvatica come strategia di sopravvivenza. La recente proibizione della caccia nella riserva ha compromesso questo tipo di sussistenza e l'opportunità di assicurarsi delle entrate e ha determinato una forte propensione per lo sviluppo delle attività d'allevamento. Ma la modernizzazione dei sistemi di allevamento e l'introduzione di nuove leggi per le aree di pascolo nella Cina occidentale potrebbero a lungo termine entrare in conflitto con gli obbiettivi di conservazione della riserva. In uno scenario di mutamenti climatici, di una storia complessa d'immigrazione, di sforzi governativi per sviluppare le risorse minerarie e i pascoli della regione insieme a interessi nazionali e globali per la protezione di una biodiversità tipica, il futuro del Chang Tang è molto incerto. La misura in cui la Regione Autonoma Tibetana prenderà provvedimenti a lungo termine per una gestione globale ed efficace, che si riferiscono a questioni di sfruttamento delle aree montuose, determinerà in definitiva il successo degli sforzi per raggiungere il duplice scopo di innalzare lo standard di vita dei nomadi e conservare la biodiversità davvero unica della regione.

INTRODUCTION

The Chang Tang or "northern plains" region of northwest Tibet is the highest (averaging >4,500 m elevation) and most remote part of the Tibetan Plateau. Its isolation and relatively low productivity due to low temperatures and dry climate have left it relatively little exploited and the abundance of its wildlife populations today is testimony to this avoidance by humans. To Tibetans the term Chang Tang connotes an empty wilderness and in a sense an unconquered frontier. There is no specific boundary to the Chang Tang, its application has apparently changed over time, with small remote areas of the Plateau currently applicable, but today its primary location is generally viewed as the region north of the Amdo-Gertse-Senge Kabab road (Fig. 1), the main northern route across the Plateau. But even in such a remote area as this, human exploitation has increased rapidly over the past century

and continues to do so today (Fig. 2). Human use has never been static, but change in the past was slow, from a strictly hunting use perhaps as much as 20,000 years ago in the eastern Chang Tang (Brantingham *et al.*, 2001), to initial livestock herding probably several thousand years ago (Goldstein & Beall, 1990), to a modernising pastoralism and hunting livelihood with many outside influences within the past century (Næss *et al.*, 2004). Above 33° N in what is now Ngari Prefecture and western Nakchu Prefecture, for example, there was probably only limited seasonal use of summer grazing areas up to several hundred years ago, coupled with hunting excursions, and few

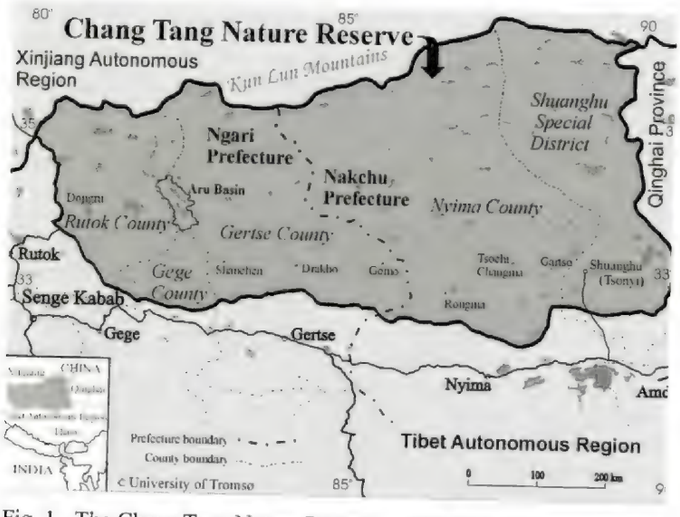

Fig. 1 - The Chang Tang Nature Reserve, a 300,000 km² protected area covering much of the northwest part of the Tibet Autonomous Region (TAR). Economic development of this sparsely populated area, home to some 20,000 nomadic pastoralists and their livestock, is expected to be tied closely to the biodiversity conservation goals of reserve.

if any people lived permanently on the Plateau north of this latitude. About 300 years ago, apparently driven by conflict and/or hard economic conditions in the southern Amdo region of the eastern Tibetan Plateau (today's Qinghai Province), groups of people emigrated westward, settling in parts of the western Chang Tang (Huber, 2004; D. Tsering, unpublished data), in what is now northern Ngari Prefecture where empty or only lightly inhabited areas were available. More recently, in the late 1950's and early 1960's, additional groups of people left Qinghai and settled in the western Chang Tang, and still other groups from similar areas in the east apparently became stranded while on pilgrimage and were settled by government authorities, with significant occupation in both instances occurring in the northern Ngari Prefecture Counties of Rutok, Gege and Gertse. Township divisions in these northwest Ngari Counties today often reflect cultural differences associated with the various groups of immigrants. Human and livestock populations have apparently increased since the immigrations of the 1950's and 1960's and government development support is increasing. Today's northern township centres of Dongru, Shanchen, Drakbo and Gomo (Fig. 1), for example, have seen substantial government support to infrastructure and development activity over just the past decade.

This history of settlement in Ngari Prefecture, however, contrasts notably with that in the portion of the Chang Tang just to the east in western Nakchu Prefecture (86°-90° E), where areas above 33° N were essentially unsettled and little used, except for hunting, until the early 1970's when a concerted effort was made by Nakchu Prefecture's western Counties to settle and thus exert con-

Figure 2 - A nomadic pastoralist encampment (4,980 m) during May in the northern Aru Basin (34° 20' N), one of the northernmost examples of year-round human inhabitation in Tibet's western Chang Tang, and an area used primarily for seasonal grazing and hunting prior to 1990. Within the landscape of this view we have observed thousands of chiru as well as gazelle, kiang, wild yak, blue sheep, marmot, hare, pika, wolf, brown bear, fox, weasel, and sign of snow leopard and lynx.

trol over rangelands to the north. Substantial settlement programs north of 33° N were initiated in Nyima County and the Shuanghu Special District at this time, including initial location of the present northern township centers of Rongma, Tsochi Changma, and Gartso, and the special administrative center at Tsonyi (Fig. 1). Township centre infrastructure has greatly improved over the past few decades, and in the last 5 years development in Shuanghu has proceeded even more rapidly with inputs associated with China's policy for eastern companies and cities to contribute directly to development in the west.

Difference in the recent settlement pattern between

Nakchu and Ngari Prefectures was brought about in part because of different policies associated with Ngari Prefecture being under the control of the Xinjiang Autonomous Region until 1980, and also because the emigrating groups from Amdo (Qinghai) wanted to get as far as possible from there. There is also some evidence, although specific cases are difficult to confirm, of movements of people from Ngari to western Xinjiang Autonomous Region when it was created and back once Ngari became part of the TAR. Otherwise, it appears that following the Cultural Revolution in about the mid 1970's, when Ngari was still part of Xinjiang, at least one remote nomad community in northern Ngari, in the Aru Basin – Lumajangdong Lake area – was relocated to a site near the administrative centre of Rutok, probably to facilitate administrative control and education. There is little other evidence, however, of substantial restriction of use in northern areas at this time, although expansion may have been limited. Following new changes in social policy, by the late 1980's authorities in the new TAR prefecture of Ngari demanded the return of these previously resettled nomads and promoted increased use of northern areas, in part as a strategy to expand rangeland exploitation and secure County boundaries and grazing rights. Official redistribution of these boundaries, which took place in the early 1990's, is testimony to the efficacy of such policy, notable in the Aru Basin and vicinity. Over the past 10-15 years increasing government support to development in both northwest Nakchu and northeast Ngari, in the form of food aid, livestock replenishment, and health care, has contributed to a rise in human and livestock population in these areas at rates not seen in the past. The end result of these recent immigration events and development policies has been a dramatic increase in human exploitation of Nakchu's and Ngari's Chang Tang rangelands north of 33° N, especially in the past 40-50 years.

Human population density in the Chang Tang is still relatively low, even by Tibetan standards, but in a region of naturally low primary productivity its effect on the natural ecosystem can be significant. Along with livestock production, hunting of the abundant wildlife has been an important survival strategy for these peoples moving into the northern plains and it has been one of the primary reasons for successful settling in some of the northernmost areas. Other exploitation of biological products, such as medicinal plant harvest, for example, has never been an important activity here as it is elsewhere in Tibet, probably because of the low productivity of the area. The primary point here is that natural resource exploitation by humans in this Chang Tang region north of 33° N has traditionally been quite low, but that within the past century it has undergone substantial change. Recourse, for example, to long-established rangeland exploitation traditions is not applicable to management in this part of the Plateau. If anything, the recent rapid rate of change suggests that delayed ecosystem responses (e.g., wildlife population change) may be in the offing, and that efforts to conserve or maintain its pristine qualities will be difficult.

The Chang Tang above 33° N still harbours a diverse and abundant assemblage of unique Tibetan wildlife and has received national and global attention regarding conservation of this biodiversity. Future trends for both conservation and exploitation of natural resources in the Chang Tang are closely tied to the rise in human and livestock populations, and the degree to which new concerns regarding biodiversity conservation will influence development directions there remains to be seen. With pastoralism development actions elsewhere on the Tibetan Plateau generally promoting increased livestock production, and invariably doing so at the expense of wildlife, it is clear that the results of such an approach would not be appropriate in areas where wildlife conservation is a major priority. Although some of the ongoing livestock development programs may be adapted to the western Tibet Autonomous Region (TAR), new approaches to pastoral development would have to be developed in conservation areas. In addition, mining has already begun in the region, and has the potential to become a substantial industry there, with negative effects on wildlife and conflict with herders already apparent. The ultimate TAR goal of enhancing resident nomads' standard of living while conserving the truly unique array of biodiversity presents a difficult challenge (Fox *et al.*, 2004a). As described below, government initiatives for biodiversity conservation are having a substantial effect on land use designation and management in the region, and their influence may significantly affect resource exploitation and development directions.

HUMAN USE OF THE CHANG TANG

Wildlife exploitation

In the northern Chang Tang, Tibetan antelope or chiru (Fig. 3) herds of many thousands still undergo summer migrations of several hundred kilometres to calving grounds, and winter breeding concentrations can fill entire basins on the plateau. Tens of thousands of Tibetan gazelle, Tibetan wild ass or kiang, and blue sheep, and thousands of wild yak and Tibetan argali sheep, along with smaller herbivores and predators are also distributed over the Tibetan highlands, but some of the best remaining areas for most species are in the Chang Tang. In other areas of the chiru's distributional range, for example, populations have dramatically decreased in recent decades and some migratory herds have almost disappeared. Chiru population reductions have been tied to the value of its hair, for which it is killed and the underwool, known as "shahtoosh", traded to be woven into shawls later to be sold for thousands of dollars in (now illegal) international markets. The exploitation of chiru in the Chang Tang reached its culmination in the mid-1990's with a spike in demand for shahtoosh, when the shawls woven in the Kashmir valley became highly valued in the international fashion industry and demand for the raw product grew

rapidly (Kumar & Wright, 1998; Schaller, 1998). Whereas the chiru had been hunted extensively as roads opened western Tibet in the 1950's and 60's, and the availability of shahtoosh may have allowed markets to expand, with a recent increase in international demand the species was by the 1990's subjected to large-scale organised poaching with modern weapons. Consequently, its populations, especially in the eastern and more accessible areas of winter concentration, began to plummet dramatically. It has been estimated that the overall population of chiru has decreased from over a million a century ago to less than 70,000 by the late 1990's (Schaller, 2000).

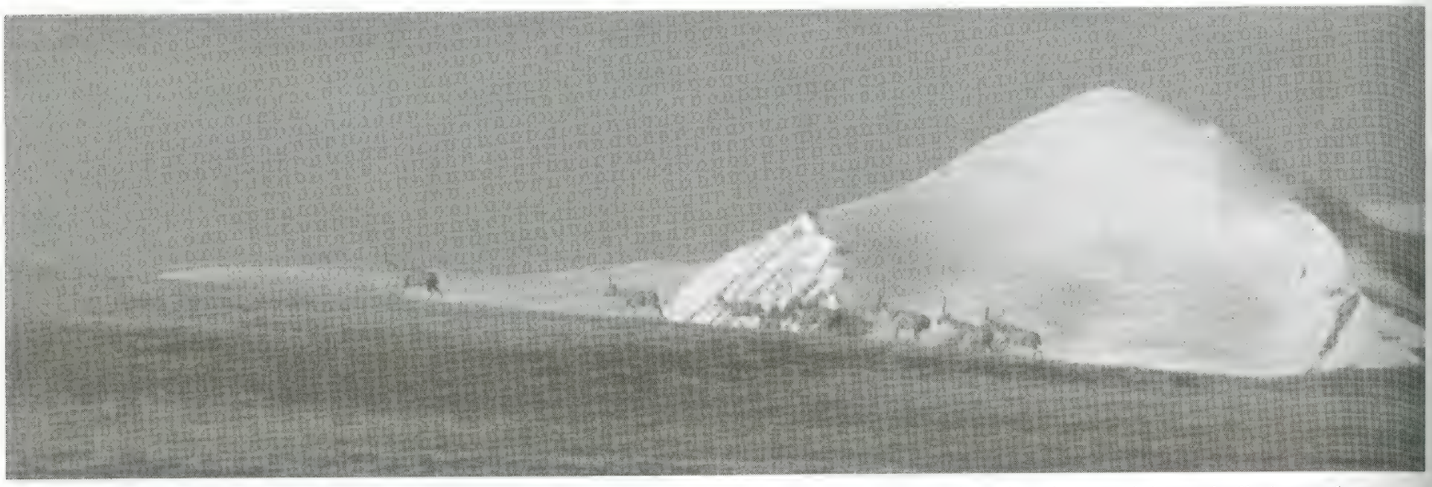

Fig. 3 - Tibetan antelope or chiru, a species of primary conservation interest in northwestern Tibet, for it has decreased dramatically in numbers within recent decades.

In reaction to this overexploitation of chiru, and concomitant hunting of wild yak and other species of the Tibetan highlands, several new nature reserves within the distribution of chiru and wild yak were designated in the 1990's with the express purpose of stemming the slaughter of wildlife. In the Tibet Autonomous Region, the largest of these, the 300,000 km^2 Chang Tang Nature Reserve (Fig. 1) was designated by the regional government in 1993, and given national level protected area status in 2001, to protect the hunted species as well as to promote general biodiversity conservation. The primary focus of reserve management to date has been to reduce hunting, and this is being seen as initially successful, although negative effects of this campaign on local residents are also apparent (see below). Even assuming success in halting wildlife slaughter, however, the issue of long-term biodiversity conservation remains a difficult question in view of the increasing human population and the apparent development of the region for livestock production. The creation and initial management of this reserve must therefore be viewed on the backdrop of the recent increases in human immigration and livestock exploitation, along with this very recent attempt to stem the slaughter of chiru. The route that the TAR and China's central authorities take to address the two goals of human livelihood enhancement and environmental conservation inside the nature reserve will greatly influence what components of the natural ecosystem in today's Chang Tang will remain for future generations.

That wildlife and people are closely intertwined in the northern Chang Tang can be illustrated by the degree to which the economics of hunting and the effects of the creation of the nature reserve have affected the livelihood of resident nomads. Whereas much of the chiru's slaughter has been carried out by organized poachers from outside the Chang Tang, and has mostly affected herds in the eastern part of chiru range (i.e., Qinghai), a market-induced increase in the smaller-scale but widespread hunting and trapping of chiru by residents of northwest Tibet, while exacerbating to some extent the species' decline, has resulted in clear benefits to nomads in the north. The long-established tradition of hunting various species for meat during hard times, and antelope for both meat and more recently for barter or sale of the skins, has been central to the nomad's survival in the far north. Thus, already experienced in the hunting that provided meat and a few chiru skins for trade to India, with the increased demand and price for skins many nomad families in the north were able to procure modern rifles to increase the hunting take and substantially increase disposable income for a number of years in the early 1990's as chiru pelt prices rose (Næss *et al.*, 2004). For example, the sale of just a hundred or so antelope skins could provide enough cash to purchase a used truck or jeep (Fig. 4), vehicles which began to appear on the northern rangelands known as some of the poorest areas in Tibet. Gone was the traditional yak caravan as seasonal camp movements and transport of animals and wool to market were now assisted by truck or jeep transport, as elsewhere in Tibet.

Whereas the modern rifles were confiscated from residents soon after the establishment of the nature reserve (e.g., in 1995 in the Aru Basin), traditional trapping and hunting methods, including use of old flintlock rifles, were tolerated due to the subsistence needs. But continued antelope hunting for skins by resident nomads led to conflict with an increasingly organised reserve management, and a deadly altercation in 2002 resulted in a policy to confiscate all weapons and traps from residents of

the northwest Chang Tang. Chiru hunting and the shahtoosh trade has gone underground, and is more difficult to monitor, but the traditional dependence on wild meat sources is now also illegal and a source of substantial discontent among the northern nomadic communities today. Maintaining the vehicles and spending habits that were procured just a few years ago is now not possible for residents abiding by the no-hunting laws. It is thus quite interesting to consider how the fashion taste of wealthy individuals in the West can have so influenced the livelihood of these pastoralist/hunters at the edge of inhabitation on the Tibetan Plateau. And the international conservationist campaign to outlaw hunting and trade in chiru wool has given little consideration to its effect on the livelihood of these northern pastoralists.

Figure 4 - Typical nomad encampment in the western Chang Tang. Trucks such as that pictured were purchased here for the first time in the 1990's, some on the proceeds of chiru hunting.

People, livestock and wildlife

The above scenario is relevant only for a relatively small number of residents in northwest Tibet, those that live at the northernmost limits of human habitation where chiru are still abundant, but it highlights the need for nature reserve management to address the loss of livelihood for these people. Hunting has traditionally been practiced in southern areas of the reserve, as well as in other areas of western Tibet (Goldstein *et al.*, 1990), but in recent decades it has not been as critical a component of life as in the north. Perhaps some small-scale sustainable hunting could be allowed for the more marginal communities of nomads in the north, although such harvests would have to be limited. The real issue, however, for biodiversity conservation in the nature reserve will probably not be hunting, but how the resident nomadic pastoralists can better their livelihoods without compromising the habitat and food requirements of the native wildlife species. In the long-term, with increasing human populations and increasing dependence on livestock production as the primary livelihood option, even if overexploitation of wildlife (overhunting) is successfully controlled, the conservation of wild species becomes an issue not of hunting but of rangeland use. The forage required by domestic goats, sheep and yaks is essentially the same as that needed to sustain the herds of chiru, wild yak, kiang, gazelle, blue sheep and Tibetan argali, as well as smaller herbivores such as marmots, pikas, hares and voles. Details of the wild-domestic herbivore interaction, e.g., forage and habitat requirements, will be important to developing management prescriptions for areas of overlap. Furthermore, in a nature reserve protection of the herbivores' predators is considered an integral part of ecosystem conservation; how will the brown bears, wolves, snow leopards, lynxes, foxes, martens, weasels and birds of prey be affected by livestock development?

Currently within the Chang Tang Nature Reserve, areas from about 34° N northward to the Kun Lun Mountains (Fig. 1) are uninhabited and livestock-free. Much of this area is over 5,000 m in elevation and is relatively unproductive and probably too marginal to support viable pastoralism, and from both a conservation and livelihood standpoint it should remain livestock free. But this area is perhaps too unproductive to support large wildlife populations either. Chirus migrate northward across these marginal steppes to calving sites, perhaps to avoid predators (wolves or insects) and/or perhaps to reach a few existing sites in the north with relatively good forage, but they return to the south for the winter and congregate for breeding in relatively productive steppe rangelands at 33°-34° N (Schaller, 1998), the very same area that has seen substantial human immigration over the past 50 years.

At issue is the trend for people to continue to move or be moved into increasingly marginal areas for livestock production in the Chang Tang. As nomad groups expand, new family units are seeking new potential pastures in the north. Although there may still be significant areas of steppeland with sufficient forage to permit productive exploitation by herders, full exploitation of these areas by pastoral-

ists may tend to reduce populations of competing wildlife species such as chiru. Part of the challenge for the pastoralists is that these high elevation northern areas are probably subject to more extreme weather events such as snowstorms and dry spells, and it is therefore difficult to derive from them a stable livelihood. People in the Aru Basin, for example, who settled there permanently for the first time in about 1990 (Schaller & Gu, 1994) have autumn, winter and spring grazing areas near a high massif of over 6,000 m (Næss *et al.*, 2004) and are apparently subject to substantially more severe snow events than other nearby areas used by herders. The potential for livestock mortality is great and these people have suffered from many episodes of snow-induced livestock die-offs (Næss, 2003). Whereas the total number of family groups in the northern Aru Basin grew from 5 to 15 over the 10 years since their permanent settlement there, in 2001 three of these families with marginal grazing areas near the mountains (affected by snow) moved out to a more benign area just to the west, but back to a location where they must share grazing areas with already established families. Has the Aru Basin reached its limit for year-round exploitation under the current livestock management regime? Certainly the recent immigration into new unused or previously little used areas has been so common in the Chang Tang that the limits of either pasture production or the effects of weather uncertainty have not been tested over time in these areas. Thus, although areas of steppe are still available that can be exploited by herders, whether viable and stable livelihoods can be maintained is open to question, especially with the recent loss of legal hunting.

To be realistic, development initiatives to enhance livestock health and survival can probably make livestock husbandry under modernising conditions economically viable in many northern areas, but to make this feasible in marginal areas, it will probably be even more important to eliminate the predators that take livestock and the herbivores that compete for forage. This is not a solution, however, that is consistent with the goal of a nature reserve ostensibly designed to conserve natural biodiversity. These will be hard issues to address for management in the Chang Tang Reserve, for it will most likely mean designating some areas as livestock-free, and placing limits on numbers of livestock below rangeland carrying capacity, something not even seriously contemplated at this time. In fact, some of the best wildlife areas today in the Chang Tang Reserve (i.e., areas with good forage resources) are in locations that have very recently been subject to new herder settlement or are being considered for such. For example, in 2000 in Nyima County, Nakchu Prefecture, 12 poor households and their livestock from overstocked areas south of Nyima town were moved into uninhabited areas well inside the reserve about 70 km north of Rongma, at the edge of the reserve's designated core area, and within prime wintering grounds for the chiru population in this area. Although the livelihood standard for these people has clearly increased, it is difficult to see how goals of the nature reserve can be served by such settlement of the northern areas, especially in important wildlife areas. Although no further such resettlement into reserve areas appears to be currently planned by Nyima County, the expansion of existing northern communities continues. It is curious that this national level nature reserve has no specific policy regarding the expansion of livestock husbandry inside the reserve. If the substantial herds of wildlife now present are to be maintained in at least some areas, then strong reserve management is undoubtedly needed to control livestock populations, with some areas kept livestock-free especially during critical wintering periods.

Effects of climate change

Complicating the issues of wildlife conservation and livestock production, however, are the potential effects of climate change on the Plateau. Predictions vary somewhat, but a warming of climate and continued drying of the highlands of western Tibet appears likely. Assuming such were to take place, the present dry steppeland would probably produce less forage, whereas the higher (colder) elevations that continued to receive sufficient precipitation (near mountain massifs), and sites with surface moisture derived from mountain water sources, would become more productive with the higher temperatures or longer growing season. We are already apparently seeing some of the effects of warming, for it appears that lakes throughout the Tibetan Plateau have been rising over the past decade or so, caused most likely by their permanent snowfield water sources melting at faster rates under the warmer temperature regime. Such is consistent with the rapid retreat of glaciers documented in the main Himalayan region. In fact, very recent interviews with local residents have shown that lake level rises resulting in the flooding of productive grazing areas is considered the second largest environmental problem (after brown bear attacks) for Chang Tang residents. Although some areas have more water today, this is likely to be short-lived in areas where remnant snowfields are small and will disappear in the near future. But continued climate warming would perhaps mean that areas currently seen as marginal to livestock production, i.e. high elevation northern areas near mountain massifs that receive sufficient moisture, may increase in productivity as temperatures rise and be more amenable to livestock production. It is thus in part a question of maintenance of wild species versus human exploitation with domestic herbivores. But the also predicted trend toward more variability in weather and intensity of extreme events may make such areas more subject to severe snow events that kill livestock. The prognosis for successful livestock exploitation farther north in the Chang Tang is highly uncertain. The effect of climate change on wildlife distribution and abundance. e.g., migrations, is equally uncertain.

Grassland management policy and exploitation of the steppe rangelands of northwest Tibet

The northwest Tibet Autonomous Region is one of the least productive and poorest parts of western China. At an average elevation of over 4,500 m it is too high to support any cropping, and nomadic pastoralism remains the primary livelihood for most residents. Whereas other parts of the Tibetan Plateau in the TAR and Qinghai Province

have seen significant livestock and community development activity, the northwest TAR has yet to see much. Officials are admittedly looking to financial advantages associated with nature reserve designation as one means to improve nomads' livelihoods, but how this will work is as yet quite unclear. On other parts of the Tibetan Plateau programs in pastureland privatisation and a concomitant livestock "ranching" approach to management are changing the scope of pastoralism by decreasing mobility while trying to stabilise livestock numbers (i.e., limit the extent of die-offs). But, unlike the traditional pastoralism that co-existed with abundant populations of large wild herbivores, these development actions have the potential to fully utilize the productivity of the rangeland, and exclude wildlife. One can envision, for example, that over the past millennium or two in the traditional pastoral system of west Tibet the frequent episodes of snowfall-induced livestock mortality kept pastoralist livestock density well below forage carrying capacity and allowed a coexistence with abundant wild herbivores. Although the wild herbivores were also undoubtedly affected by severe snow storms, if they were better able to deal with or recover from such environmental conditions, then the available forage would have supported their substantial populations in addition to the moderate livestock numbers (Fox *et al.*, 2004a). The modernisation of livestock husbandry changes this dynamic, to the detriment of competing wildlife. Individual household-based grassland management reforms developed for western China, with concomitant division and fencing of pastures, are also being introduced to parts of the TAR, but there may be some scope for retention of group management of shared pastures more appropriate to the larger scale grazing patterns required in the less productive rangelands of the west (Richard, 2003; Banks *et al.*, 2003). Nevertheless, standard initiatives to increase livestock productivity are being introduced throughout the region and are likely to greatly alter the scope of pastoralism across the TAR.

Development of a viable modern livestock production system, as elsewhere in the world, will incorporate increasing pressures to remove predators, control burrowing pests such as pikas and rodents, increase efficiency of pasture utilization, convert the most productive wetland sites to hay/fodder production, exploit below surface water resources, and fence pastures (see Freilich *et al.*, 2003). Although the traditional pastoral system in western Tibet has certainly had some effect on wild predator and large herbivore populations, it is small compared to that of the ranching style management actions listed above, and likely to be used more in the future as this part of Tibet develops and modernises. Additionally, mining will likely be a significant future land use in western Tibet; for already gold mining operations are in place in the remotest of locations and organised mineral exploration is underway throughout the region. The effects of these types of developments often result in challenges to conservation of native biodiversity, and need to be closely assessed, controlled in designated protected areas where biodiversity conservation is a high priority, and mitigated for where an accommodation of development to conservation goals is deemed appropriate.

The establishment of the Chang Tang Nature Reserve has created the potential for a large-scale effort to combine wildlife conservation with pastoral development in western China, and the application of livestock development initiatives appropriate to its biodiversity conservation goals will be the reserve's greatest challenge. Recognizing and adapting to a highly variable and unpredictable climate in western Tibet that limits the ability to maintain stable livestock populations is likely to be a major focus (Miller, 1998; Miller & Schaller, 1997). Although drier than elsewhere in Tibet, the importance of environmental variability (including rare snowstorm events) as a determining ecosystem component is probably paramount in western Tibet. Adapting both wildlife management and regional livestock development initiatives to such an environmental regime (very different from the eastern Plateau) is necessary but also likely to be a major challenge (Fox, 1997; Fox *et al.*, 2004a), and even more so in conservation areas where both pastoralists and wildlife are expected to coexist. Because current livestock development actions underway throughout western China leave essentially no room for conservation of wild herbivores, their direct application to nature reserves is clearly not appropriate. Devising alternative livestock development actions and maintaining some livestock-free zones that are appropriate to nature reserve goals will be a major challenge, but in the end will determine the success or failure of such protected areas.

APPROPRIATE MANAGEMENT ZONATION IN THE CHANG TANG NATURE RESERVE

Today, some 20,000 nomadic pastoralists depend on rangelands within the Chang Tang Reserve for livestock grazing, a small number by any standards in such a large area, but these are people whose livelihood needs must be addressed and accommodated to biodiversity conservation goals if the reserve is to be successful. Only a small portion of those are greatly affected by the hunting ban, as described above, but for those people livelihood options alternative to livestock production need to be to considered most seriously. In a protected area the size of the Chang Tang Reserve, with a significant resident human population, it is clear that various zones of protection need to be established, some with wildlife conservation as the highest priority and others with an accommodation of pastoralism and wildlife as the goal. And the application of such zonation needs to rely on accurate information about critical areas for wildlife populations of special interest. Without such a zonation, and its concomitant variation in land use management, the general development of livestock husbandry livelihoods for all peoples in the reserve will result in land use patterns and biodiversity values little different from those outside the reserve.

This is an important issue, for at present officials with management responsibility for the nature reserve support a theory that the presence of human populations in chiru habitat acts to protect the species. Because such resident

nomads can act to deter incursions by outside commercial hunters, an increasing human presence is currently not seen as a major threat to chiru or wildlife conservation in general. How significant such protection might in fact be is debatable, for some hunting is likely to continue in the northernmost and other isolated areas. And in initial surveys across the northern inhabited areas of the reserve, it is clear that the highest densities of chiru are in areas of low human and livestock presence (J. L. Fox & B.-J. Bårdsen, unpublished data). In any case, regardless whether or not local residents deter poaching, in the long term the real concern for conservation of chiru and the other wild herbivores is an increasing demand for livestock grazing areas associated with human exploitation of the northern steppes. In at least some parts of the huge Chang Tang Reserve, critical habitat areas need to be designated as priority zones for wildlife conservation, and livestock excluded or greatly restricted, for example in the wintering areas for chiru. Current reserve management plans (TARFB, 1999) do not include clear zonations in this regard. Without such management, the biodiversity values still seen today will disappear as they have with increased human exploitation elsewhere on the Plateau.

Various approaches have been suggested to obtain conservation-oriented livestock development, including assurance of the nomads' rapid and opportunistic access to markets, and the improvement of animal survivorship, health and product quality to increase per animal monetary returns, while at the same time incorporating limits to livestock numbers (e.g., Fox *et al.*, 2004b). Rangeland use patterns that avoid livestock disturbance to or overuse of critical wildlife habitat need to be identified and incorporated into management. Alternative livelihoods for residents include employment within the reserve's management and research infrastructure, and in a limited tourism industry that is likely to develop. But what is required most critically at this time is a well-coordinated infrastructure for reserve managers to consult with the local residents, various government management agencies and civil authorities to develop and implement a management structure for the reserve. Such a system needs to identify clearly and effectively oversee different zones of management for different levels of biodiversity protection and natural resource exploitation within the large expanse of the reserve. The success of such a management structure will determine how well the resident nomads' livelihood needs are met and how much of western Tibet's natural ecosystem functioning and its biodiversity remain intact within the reserve.

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Biodiversity conservation and natural resource exploitation on Tibet's northwest Chang Tang highlands
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Volume XXXIII - Fascicolo I

George B. Schaller, Lü Zhi, Wang Hao, and Su Tie

Wildlife and nomads in the eastern Chang Tang Reserve, Tibet

Abstract - Extensive wildlife surveys were conducted on the treeless steppe of the Tibetan Plateau between 1985 and 2001, principally in what is now the Chang Tang Nature Reserve in Tibet. These provided a baseline of information on the natural history of chiru, wild yak, kiang, and other large mammals, as well as on the impact of nomads and their livestock on this high-altitude ecosystem. We returned in 2003 after a decade of absence to census wildlife in a part of the reserve we had twice censused in the early 1990s. At that time illegal hunting especially for chiru and wild yak was intensive. Our new survey showed that all species had increased locally with the protection given them in recent years in that area, with kiang doubling in number. However, some of this increase may have been due to changing patterns of movement in certain species. This increase has created problems with wildlife: wild yak bulls abscond with domestic yak cows, and kiangs compete with livestock for forage. The human and livestock populations have increased greatly in the past quarter century and rangeland is being degraded. Furthermore, since 1996 the steppe has been privatized in that every nomad household has received its own tract of land. The future of large wild mammals in the reserve now depends on the goodwill of the nomads and on sustainable management of the rangeland, livestock, and wildlife.

Riassunto - Fauna selvatica e nomadi nella parte orientale della Riserva del Chang Tang, Tibet.

Tra il 1985 e il 2001, indagini approfondite sulla fauna sono state condotte nella steppa priva di alberi dell'altopiano tibetano principalmente in quella che ora è conosciuta come Chang Tang Nature Reserve. Le indagini hanno fornito informazioni di base sulla storia naturale del chiru, yak selvatico, kiang ed altri grandi mammiferi, nonché sull'impatto dei nomadi e del loro bestiame su quest'ecosistema d'alta quota. Nel 2003, dopo un decennio d'assenza, siamo ritornati per censire la fauna in una zona della riserva già censita all'inizio degli anni novanta. In quel periodo la caccia illegale, in particolare del chiru, era molto diffusa. La nostra nuova indagine ha mostrato che, a seguito della protezione loro fornita negli ultimi anni in quest'area, tutte le popolazioni delle specie presenti localmente sono aumentate ed il numero di kiang è raddoppiato. In qualche caso, tuttavia, l'incremento può essere stato determinato da cambiamenti del modo di spostarsi di alcune specie. L'incremento delle popolazioni ha creato alcuni problemi per la fauna: i maschi degli yak selvatici scappano via con le femmine di yak domestici, e i kiang competono con il bestiame per il foraggio. La popolazione umana e i capi di bestiame sono notevolmente aumentati nell'ultimo quarto di secolo e le regioni montuose si stanno degradando. Inoltre dal 1996 la steppa è stata privatizzata e ogni famiglia nomade ha ricevuto un pezzo di terra. Il futuro dei grandi mammiferi della riserva ora dipende dalla buona volontà dei nomadi e da una gestione sostenibile di aree montuose, bestiame e fauna selvatica.

INTRODUCTION

Grasslands cover about 71% of the 1.22 million km^2 Tibet Autonomous Region. On these vast treeless steppes, most lying between 4,300 and 5,300 m in elevation, too high for agriculture, animal husbandry is the main livelihood with sheep, goats, and yaks the principal livestock. The northwestern part of Tibet, as well as the adjoining parts of Qinghai to the east and Xinjiang to the north, are known as the Chang Tang (northern plain in Tibetan).

In 1993, Tibet established the Chang Tang Nature Reserve, designating it as a multi-use area supporting both nomadic pastoralists with their livestock and a unique assemblage of large wild mammals, of which several species are endangered and endemic to the Tibetan Plateau. The aim of the reserve is to maintain a healthy, productive, and diverse ecosystem with vigorous populations of all animal and plant species coexisting with the nomads and their livestock. The reserve is huge, around 300,000 km^2, about the size of Italy, but its precise size remains uncertain because the southern border had not been defined as of 2003. Other protected areas are contiguous with the Chang Tang Reserve, the Kekexili in Qinghai and the Arjin Shan and Mid-Kunlun in Xinjiang, together encompassing around 500,000 km^2.

With much of the reserve lying above 4,500 m, the vegetation is dominated by a cold-desert rangeland with a sparse cover of grasses, sedges, forbs, and low shrubs. Four principal vegetation formations occur in the reserve (Miller & Schaller, 1997). Alpine meadow with a dense mat of sedges (*Kobresia* sp.) and forbs is mainly riparian where soil remains saturated with water, but to the east, as in Qinghai, where precipitation exceeds 400 mm per year, this habitat is extensive. Alpine steppe covers about half of the reserve, mainly south of 34° N *Stipa* sp. dominates and various forbs such as *Oxytropis*, *Potentilla*, and *Leontopodium* are common. Although plant coverage is generally less than 30% and the soil is poor without sod layer, this formation provides the most important pasturage for wild and domestic ungulates. North of the alpine steppe is a transition zone where good grazing is patchy to an alpine desert at 5,000 m and higher dominated by a coarse sedge (*Carex moorcrofti*) and a low shrub (*Ceratoides compacta*). Roughly 20% of the reserve con-

sists of alpine desert. The transition zone is little used by nomads and the alpine desert not at all, because fresh water and adequate pasture are too scarce to support livestock. Wildlife is also sparse in that region except that migratory Tibetan antelope or chiru (*Pantholops hodgsoni*) move north to calve. Nearly a third of the reserve consists of high-altitude cushion plants, rocky ground, and glaciers, all habitats unsuitable for ungulates. In addition, lakes of varying sizes, most of them saline, are scattered throughout. Schaller (1998) and Lü & Springer (2000) describe the region in detail.

One of us (GBS) began research in the Chang Tang in 1985 to ascertain the status and distribution of large mammals, evaluate conservation needs, and encourage protection of critical areas. Fourteen trips had been made by 2001, most of them to the Chang Tang in Tibet, in collaboration with Chinese, Tibetan, and Uygur coworkers. Intensive wildlife censuses were made at certain sites. One of these was on alpine steppe in the southeast of the reserve roughly between 33° 00'—33° 30' N and 86° 30'—89° 00' E. The terrain in that area is rolling to hilly and broken by three ranges with glaciated peaks of 6,000-6,200 m, the Amu Kangri in the east, the Jangngai Kangri along the north, and the Mayer Kangri in the west (Fig. 1).

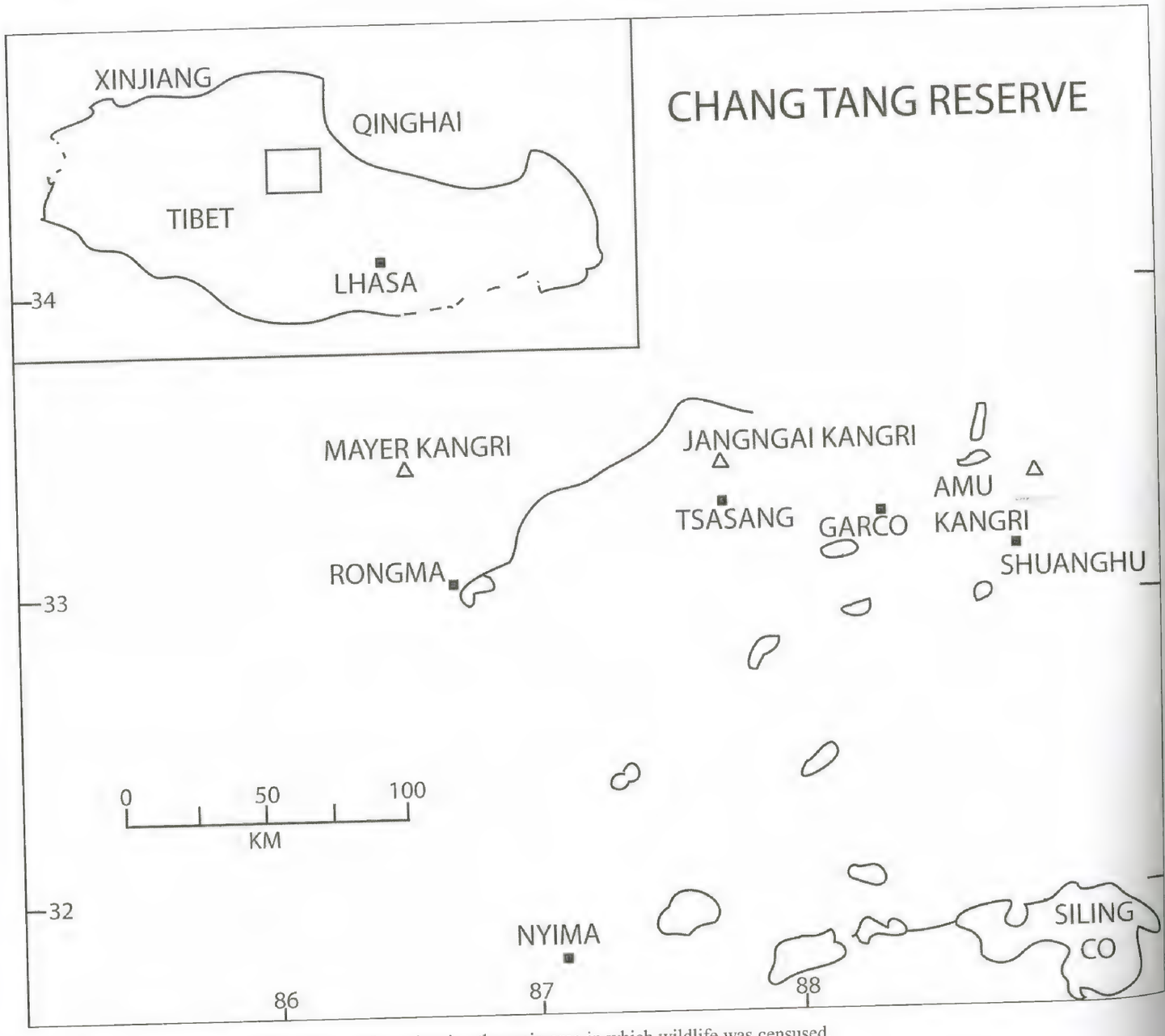

Fig. 1 - The southeastern part of the Chang Tang showing the main area in which wildlife was censused.

There we censused wildlife over 17,500 km² in December 1991 and over 10,500 km² in October 1993. We drove across the terrain, using the same routes as much as possible during the two censuses, and counted all large mammals within view. This provided a minimum estimate of numbers of chiru, Tibetan wild ass or kiang (*Equus kiang*), and Tibetan gazelle (*Procapra picticaudata*) that mostly inhabit plains and low hills, but does not give an accurate assessment of blue sheep (*Pseudois nayaur*) and Tibetan argali (*Ovis ammon hodgsoni*) that, though occasionally seen, are high in hills near rugged terrain. Wild yak (*Bos grunniens*) can often be spotted at

a great distance even high up because of their black bulk. Of the large predators, wolves (*Canis lupus*) were encountered moderately often, lynx (*Felis lynx*) and Tibetan brown bear (*Ursus arctos pruinosus*) rarely, and snow leopard (*Uncia uncia*) never.

In April 2003 we visited the southeastern part of the reserve again to evaluate conditions and note any changes that may have occurred in the past decade. At the same time we censused the same area as in 1991 and 1993 (see Schaller, 1998). The emphasis of this paper is on describing the changes we noted.

THE NOMADS

Stone artifacts indicate that hunters penetrated the northern Chang Tang over 10,000 years ago. When the first Europeans crossed these expanses in the late 1800s and early 1900s they came across nomadic pastoralists in the same localities they occupy today but their numbers were few and presence seasonal. Now nomads reside permanently in all parts of the reserve wherever grazing is good (Fig. 2). In 1993 over 4,100 households comprising 22,000 people used the reserve as did 1.4 million head of livestock, and numbers have since then increased. The increase is well illustrated by our census area. Roads penetrated the region in the 1950s and 1960s and the Shuanghu administrative center was established. Nomads then settled in the area, and these were augmented in the 1970s when the government relocated nomads from the south and created the communes (cooperatives) of Garco, Tsasang, and Rongma. These administrative units, termed xiang, persist today, the first still a collective (the only one in Tibet) and the others under a household contract responsibility system.

Fig. 2 - Several permanent villages, as this one in the Garco cooperative, now exist in areas where half a century ago there were only seasonal nomads.

Although nomads are often thought to be free to roam in search of the best seasonal pastures, those in Tibet have for centuries been limited in movement. During the first half of the 1900s and before, a nomad household owed allegiance to and was bound by heredity to a monastery or elite family to which it paid takes in wool and butter and provided free labor. A household owned its livestock for which it was allocated certain pastures. These were adjusted every three years depending on amount of livestock and number of family members (Goldstein & Beall, 1990). When China took complete control of Tibet in 1959 the old system persisted except that the triennial pasture allocation ceased. In areas with low human and livestock populations this system maintained the range-

land in a sustainable condition. With the Cultural Revolution in the late 1960s all private property was abolished and communes established. Forced sale of livestock and high taxes created widespread poverty. Then in 1981 the communes were disbanded and livestock became private again, though with imposed limits on number of animals, usually between 40 to 70 per person depending on area. Households remained part of a xiang, whose two leaders – an administrative head and Party Secretary – allocated winter, spring, and summer pastures. Between 1996 and 2002 Tibet's government implemented yet another drastic change in land tenure policy. Rangeland was privatized with every household receiving a specific parcel of land to manage. If a household needs more space for its expanding herds, its only option is to lease land from a willing neighbor; the xiang now lacks the power to adjust pastures. Limits on amount of livestock have been removed, but the government can order reductions. This change in land tenure will have far-reaching consequences not only on the condition of rangeland but also on wildlife which now resides on private property.

People and livestock have been increasing in the xiang within the census area during the past quarter century, as shown by the Tsasang xiang (Table 1).

Tab. 1 - Growth of human and livestock populations in the Tsasang xiang, Chang Tang Reserve. Data kindly provided by the Tsasang xiang.

	1976	1990	1993	2002
Number of persons	496	702	706	852
Number of households	90	103	109	137
Number of livestock				
Sheep	35,700	32,662	37,163	54,588
Goats	6,800	14,026	17,191	20,117
Yaks	2,100	1,551	1,834	3,338
Horses	92	320	358	635
Total livestock	44,692	48,559	56,546	78,678
Livestock per person	90	69	80	92

The growth of the human population has been natural after the forced initial resettlement of the 1970s, except for a few immigrants who moved back to Tibet after fleeing to Xinjiang in the 1960s. However, in 200l the government moved 12 poor families for unknown reasons into a special wildlife core area north of Rongma. Similarly the population of Garco increased from 55 households and 356 persons in 1976 to 96 households and 513 persons in 2002, and livestock increased from 33,000 to 47,500 with an average of 93 animals per person in both years. Rongma, with 775 persons distributed in 146 households, had 94,141 head of livestock or 121 animals per person in 2002. Goats tended to increase in proportion to sheep during the 1990s because of the high value of cashmere wool. Yaks thrive best in an alpine meadow habitat, which is scarce in the reserve, and households keep relatively few. Horses have largely become a luxury during the past decade because nomads often ride motorcycles instead and either own a vehicle or have access to one.

THE WILDLIFE

The Chang Tang looks bleak, its environment harsh, with average annual temperatures below freezing, snow in summer, winter temperatures to minus 40° C, and the vegetation sparse, the biomass at best 80-160 kg/ha dry weight. Yet it once had an extraordinary number of wild ungulates of six species, or seven species if the white-lipped deer (*Cervus albirostris*) is included from nearby Qinghai. Rawling (1905) wrote that "as far as the eye could reach, were thousands upon thousands of doe antelope with their young…there could not have been less than 15,000 or 20,000 visible at one time". Of wild yak, Bower (1894) noted that "there were enormous numbers of yak about", and Hedin (1903) found "yaks and kulans [kiang] remarkably numerous". These vast herds are no more. No detailed wildlife census of the whole reserve has been done. Schaller (1998) estimated 35,000-40,000 chiru in the reserve, divided into four migratory populations and several small resident ones. The females of one migratory population travel north into Xinjiang to calve and those of another northeast into Qinghai. The number of wild yak was estimated at 8,000 in the reserve, about half of all surviving on the Tibetan Plateau, and of kiang about 22,000-28,000, to name just three species. Domestic ungulates outnumbered wild ones 13:1, and there were about 345 kg of domestic ungulates and 40 kg of wild ones per km^2.

What was the cause of the great decline in wildlife during the past century? Principally indiscriminate and uncontrolled killing by nomads, miners, truck drivers, soldiers, officials, expeditions, and others.

Fig. 3 - Two male Tibetan antelope or chiru spar while a third looks on. The light-colored wool of males is more highly priced on the international market than that of females.

The sparse nomad population had traditionally hunted for subsistence and a little extra income with muzzle-loader and foot trap without markedly decimating any species. But with road access, availability of modern rifles, and a ready market, wildlife began to be slaughtered commercially. During the famine years of 1959-1960 wildlife was killed systematically for food. As late as the early 1990s some xiang still sent trucks far into the Chang Tang to kill wild yak and kiang for local consumption and sale in towns in spite of the fact that both species were fully protected by law. Yak and kiang also have medicinal value: yak blood cures blood disease and kiang meat alleviates digestive problems.

Starting in the late 1980s the chiru was slaughtered in large numbers - estimated at 20,000 a year by the Chinese government - because of its fine wool which is smuggled out of China to Kashmir in India, often via Nepal, where it is woven into shahtoosh shawls for sale on the international market for as much as $15,000 each. Chiru are wholly protected in China and they are in Appendix I of CITES. One chiru provides about 100-125 g of wool and three chiru make one shawl (Fig. 3). China had by 2001 confiscated 1,100 kg of wool and 20,756 hides, and India intercepted 943 kg of wool and raids on shops yielded 598 shawls. Seizures in Italy, France, England, and Hong Kong totaled 1,325 shawls (Wright & Kumar, 1998; Zhen, 2000). The scale of poaching can also be judged by the number of hides in possession of commercial gangs when arrested in the field: one with 1,334 hides in 1993, one with 892 in 1996, one with 432 in 2002, and two with 712 hides in 2003. These motorized poaching gangs penetrate uninhabited terrain where they may kill females while concentrated on the calving grounds. Weaving and sale of shawls was banned throughout India as of 2000, but killing and trade continue in spite of effort to suppress them. A great and beautiful wildlife spectacle has been reduced to a remnant through ignorance, neglect, and greed to satisfy a fashion craze by the wealthy.

Instead of managing wild yak, chiru, and other species as a valuable resource to be harvested sustainably and for profit both by nomads and the government, they are being squandered. However, enough animals remain to provide incentive and opportunity to rehabilitate the populations. All options remain open.

THE 2003 WILDLIFE CENSUS

Our April 2003 census covered the same general area as in 1991 and 1993 except around the periphery when more terrain was transected in 1991. All four ungulate species were more abundant in 2003 than a decade earlier, some of them markedly so (Table 2).

Tab. 2 - Minimum number of four wild ungulate species counted in a census area in the southeast part of the Chang Tang Reserve.

	12/1991	10/1993	4/2003
Area censused (km²)	17,500	10,500	11,870
Chiru	3,900	3,066	6,285
Tibetan gazelle	352	404	621
Kiang	1,224	1,229	2,266
Wild yak	13	2	240

Chiru move little on their winter range and the censuses in the early 1990s are indicative of those in the census area. In 2003 the chiru had congregated temporarily, some traveling up from south of the census area before migrating north, and the population had not doubled as the results suggest. Nevertheless the population appears to be recovering after the intensive hunting in the 1990s. Gazelles also were more abundant, and kiang numbers may have doubled. Heavily persecuted, the surviving wild yak had largely retreated from settled areas north into uninhabited terrain. Now, with protection, herds are drifting south again into parts of their former range according to nomads. This is reflected in our census results. We would like to stress that the wildlife increase has been local and may partly have been the result of changing patterns of movement in some species such as yak. The size of populations in the reserve as a whole remains at present unknown.

The increase in wildlife is due mainly to the efforts of the Tibet Forestry Department and the xiang, county, and prefecture officials. Anti-poaching patrols visit the census area and other parts of the reserve, though the protection staff is small, only 35 forest police and 167 local guards. Rifles have been confiscated from most households. Contracts between the government and xiang and households have been made to protect wildlife. Some poaching does persist, as can also be deduced by the shyness of animals in the census area at the sight of a vehicle, but it is clear that protection has led to visible success in the corner of the reserve and adjoining parts to the south we visited.

WILDLIFE PROBLEMS

Protection has enabled species to increase or change their behavior, and this has created local problems of concern to nomads and officials. Such problems are sometimes more perceived than real and could be reduced or resolved with some thought and initiative. However, local concerns must be addressed if wildlife and nomads are to coexist under increasingly crowded conditions.

Brown bears have become more habituated to people with the result that they may kill penned livestock and break into huts in search of food. For example, between 1999 and 2002 the Garco xiang lost 117 sheep and goats and six huts were vandalized. Bears were shot in the past; now deterrents must be developed.

Wild yak occur mainly in the northern part of the census area. During the August-September rut wild bulls may attack, injure, and occasionally kill a person who ventures near. They also mate with and drive away domestic yak cows. Sixteen persons were injured by bulls between 1990 and 2003 in the Garco *xiang,* and bulls also absconded with 349 domestic yak cows. Women are afraid to venture near their free-ranging domestic herds to collect dung and milk animals, a considerable economic loss at that season. The impact on the genetic purity of wild stock through hybridization is also considerable. Once such intruding bulls were shot (Fig. 4).

Fig. 4 - Lone wild yak bulls come into conflict with herders when they attempt to mate with domestic yak cows.

We interviewed one nomad, Pujung Narla, whom one of us (GBS) has known since 1991, and he related his problem: Pujung lived in tents in the early 1990s, but now has three seasonal huts, a motorcycle, and truck. His household consists of 13 people, including children and grandchildren, and he has 1,500 sheep, 200 goats, 60 yaks, and 20 horses. In 2002 his cash income was 20,000 yuan (about $2,500) from the sale of 100 sheep and from wool (his family also ate 100 sheep). Once he supplemented his income by killing chiru. Not now. He had moved to the area in the early 1980s. "When I moved here, mine was the only family," he told us. "Now there are eleven. This is having an effect on the grassland." For the past three years he has not been able to gather his domestic yak from the hills for milking during the rut because the wild bulls are so dangerous. At first he tried to scare the bulls away with his truck but soon they lost their fear. He now has three hybrids that are too skittish to milk. And he has to tolerate the wild bulls.

Non-lethal efforts must be made to reduce problems with bulls such as educating people how to avoid injury and devise methods of chasing bulls away. One possible solution is not to permit domestic yak to roam untended in hills during the rut but to guard them on the plains were wild bulls are less likely to venture.

Kiangs are thoroughly disliked because they run into and break fences around winter pastures. Such destruction could probably be alleviated by hanging clearly visible strips of cloth or plastic on the thin fence wires that kiang may not be able to see. Of more serious consequence is the perception that kiang compete so much with livestock for forage that they should be culled for meat and hides (Fig. 5).

Fig. 5 - Tibetan wild ass or kiang may congregate into herds of 100 or more and compete locally for forage with livestock.

All evidence indicates that kiang have increased in the past decade. When in winter 100-300 kiang concentrate on a pasture, competition for grass with wildlife is inevitable. At that season kiang subsist mostly on *Stipa* grass as do domestic yaks, sheep, and goats (Schaller, 1998). However, this problem is local. Rangeland in our census area, for example, remains at present in adequate condition, able to support both wild and domestic ungulates. Toward the southern edge of the reserve and outside of it the human and livestock populations are denser and the rangeland is more or less degraded. We tallied 2,028 kiang on a one-day drive just west of the county town of Nyima. Average kiang herd size there was 41 as compared to 13 in our census area. Occasionally kiang foraged on the same small patch of pasture as the livestock. County officials agreed that the rangeland has deteriorated in recent years. They attributed it to silting from heavy summer rains, wind erosion, desertification due to climate change, competition with pikas (*Ochotona curzoniae*) and kiang - on various factors except the basic one, that of gross overstocking by livestock.

Appendix I of CITES making the import of trophies into most countries prohibited.

Protection of wildlife was the most immediate conservation issue in the Chang Tang in the early 1990s. It still remains essential. But now the need for management has intruded with its complex challenges. Conservation is not a static concept; conditions always change and to these changes new ideas, policies, research, and actions must be adapted. Conservation thus requires ever-lasting commitment and vigilance. We visited the southeast part of the reserve at a major point of transition, one in which a change in land tenure patterns and an increase in wildlife, nomads, and livestock have converged to create new problems that demand solution. The Chang Tang is a natural and cultural treasure of China and the world. To retain this heritage will require knowledge, an appreciation of its beauty, and a successful search for ecological harmony.

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Daniel Winkler

Yartsa gunbu – *Cordyceps sinensis*: economy, ecology & ethno-mycology of a fungus endemic to the Tibetan plateau

Abstract - *Cordyceps sinensis* is a fungus parasitizing the larvae of a moth of the genus *Thitarodes* (*Hepialus*), which lives in alpine grasslands of the Tibetan Plateau. Collection and trade of the caterpillar fungus is one of the most important sources of income for pastoral Tibetan communities. Tibetans know the fungus as "yartsa gunbu", "summer grass-winter worm", and often derive over 50% of their annual cash income from its collection in spring and summer. Written records in Tibet date back at least 500 years, but the market is driven by Chinese consumers, who know it as chongcao (dongchong xiacao), a highly valued tonic in Traditional Chinese Medicine. A field study in Lithang County and other sites in Ganzi Tibetan Autonomous Prefecture, Sichuan (China), analyzed the local market, and the quantity and value of the harvest. Results are contrasted to Chengdu and Lhasa market prices, which peaked at 40,000 Renminbi/kg in 2003/4. Such information as is available regarding *Cordyceps* collection in other plateau regions, such as Golok TAP and Tibet Autonomous Region as well as the Himalayas, is integrated. In addition, the mycology (esp. reproduction, taxonomy and recognition of new species), ethno-mycology, distribution and geo-ecology of *Cordyceps* are presented, based on western, Tibetan, and Chinese sources to lay a foundation for further research on the issue of the sustainability of current harvesting rates.

Riassunto - Yartsa gunbu – *Cordyceps sinensis*: economia, ecologia & etno-micologia di un fungo endemico dell'altopiano tibetano.
Cordyceps sinensis, fungo parassita che vive nelle praterie alpine dell'altopiano tibetano, attacca le larve di una falena appartenente al genere *Thitarodes* (*Hepialus*). La raccolta ed il commercio del "fungo-bruco" è una delle fonti di guadagno più importanti per le comunità di pastori Tibetani. I tibetani designano il fungo "yartsa gunbu", "estate erba-inverno verme", e dalla sua raccolta in primavera ed estate ricavano sovente più del 50% del guadagno in denaro contante. Le fonti scritte tibetane risalgono ad almeno 500 anni fa, ma il mercato è nelle mani dei consumatori cinesi, che lo chiamano chongcao (dongchong xiacao), un tonico molto rinomato in medicina tradizionale cinese. Una ricerca di campo nella Contea di Lithang e in altre zone della Prefettura Autonoma Tibetana di Ganzi, Sichuan (Cina), ha analizzato il mercato locale, la quantità ed il prezzo del prodotto raccolto. I risultati sono stati confrontati con il prezzo di Lhasa e Chengdu, che ha raggiunto 40.000 Renminbi/kg nel 2003/4. Sono anche riportate le informazioni disponibili sulla raccolta di *Cordyceps* in altre regioni dell'altopiano, per esempio nella Prefettura Autonoma Tibetana di Golok, nella Regione Autonoma Tibetana e nelle regioni himalayane. Sono inoltre descritte la micologia, (in particolare la riproduzione, tassonomia e l'identificazione di nuove specie), l'etnomicologia, la distribuzione e la geoecologia di *Cordyceps*, basandosi su fonti occidentali, tibetane e cinesi. Questi dati possono costituire un punto di riferimento per ricerche future sul tema della sostenibilità dell'attuale tasso di raccolta.

INTRODUCTION

The importance of *Cordyceps sinensis* for rural populations, especially nomads in the Tibetan areas, cannot be overstated. In past centuries it was an important bartering good to obtain tea from China, a mainstay in the Tibetan diet. Nowadays, it provides a cash income to households, which are still carrying out most of their pastoral and, where possible, agricultural activities on a traditional subsistence basis. It enables otherwise impoverished households to purchase goods, and to pay school fees, hospital bills or taxes. Collection of medicinal plants has a long-standing history in Tibetan culture, be it for personal use or for trade. With the continuous advance of a cash economy onto the Tibetan Plateau, collection of tradable plants and fungi, as medicine, as food or aroma source, has gained increasing importance, especially for rural populations who are otherwise participating only marginally in the new cash economy.

ETHNO-MYCOLOGICAL SUMMARY

The Tibetan name yartsa gunbu (*dbyar rtswa dgun 'bu*) means "summer grass-winter worm". "Grass" (*rtswa*) is also used to denote other mushrooms such as *Ganoderma lutescens*, which is also collected as a medicinal mushroom for the Chinese market in some Tibetan areas. Boesi (2003) notes that this term describes the life stages of *Cordyceps*; Tibetans "believe that during winter the yartsa gunbu lives as a worm and that, after a metamorphosis occurring at the beginning of spring, it transforms into a kind of grass. Tibetans recognise two distinct phases in the transformation process. At first, from the head of the larvae the "grass" starts growing. At this stage the worm, whitish in colour, is still alive and it is possible to see it moving over the ground with a short horn protruding from its head. Subsequently, as the season progresses, the horn continues to grow until the worm dies. When the metamorphosis is completed, the worm, [now] brownish-yellow in colour, is transformed into the root of a kind of grass".

The first mentioning of yartsa gunbu in Tibetan Medicine can be traced to the 15th Century[1], according to Yonten Gyatso's ongoing research (pers. com., 2004). Yonten points out that yartsa gunbu is mentioned in Zurkhar Nyamnyi Dorje's (*Zur mkhar mnyam nyid rdo rje* [1439-1475], 1993) text: *Man ngag bye ba ring bsrel* (*Oral instructions on a myriad of medicines*). Thus, Tibetan medicinal use of *Cordyceps sinensis* is clearly documented for over 500 years, predating the first references in Chinese Medicinal texts by three centuries (see below). In Gawä Dorje's (1995) contemporary compendium on Tibetan *materia medica* yartsa is placed in the category of "medicinal essences" (*rtsi sman*), which includes several tonics. It is used for general strengthening, boosting the immune system, virility, and is prescribed for kidney and heart problems. It is also used for treatment of Hepatitis B. In Tibetan Medicine yartsa is mostly prescribed in composite remedies, which contain a variety of ingredients to balance each other, thus optimizing their efficiency and minimizing side effects.

It is interesting to note that yartsa is collected by a majority of Tibetans who base their subsistence on traditional land use techniques, although there used to be a traditional taboo placed on digging yartsa and other medicinal plant roots. Namkhai Norbu (1997), who grew up in Derge (Ganzi TAP), reports that "Rigya [*ri rgya*], the general laws that govern relations with the environment", forbid the digging of certain tubers and yartsa gunbu. Nomads of Dzachukha and Sertar regard yartsa as a treasure of "the earth spirits". Digging yartsa gunbu provokes these earth spirits who will strike the offender, his family and clan with sickness and punish his livestock with ill health[2]. This Tibetan belief probably predates Buddhist thought. However, in Lithang Boesi (2003) did not encounter such beliefs. He speculates that "this may be related either to the loss of that belief in the area or to a different local tradition". It is very plausible that the taboo has been lost in Lithang. It can be speculated that throughout the centuries Tibetans observed Chinese collectors digging in Lithang without suffering too many ill effects. Also pointing in this direction is the fact that in Golok yartsa gunbu was not really exploited by Tibetans in the past, but large-scale exploitation was ushered in after PRC took control in the 1950s. Before that Golokpas were famous for keeping all outsiders, Chinese or Western, out of their territory, thus very successfully protecting their traditions, while Lithang was much earlier impacted by Chinese imperial policy[3].

CHONGCAO IN TRADITIONAL CHINESE MEDICINE

In traditional Chinese medicine (TCM) *Cordyceps sinensis* is known as *dōngchóng xiàcǎo*, "winter worm-summer grass", clearly the literal translation of the Tibetan name. Commonly it is just referred to as *chóngcǎo*, "worm-grass". In TCM it was first recorded in Wu Yiluo's "Ben cao cong xin" ["New compilation of materia medica"] in 1757 (Zhu, Halpern & Jones, 1998)[4]. However, Chinese doctors had learned about the healing power of *Cordyceps sinensis* earlier. Already in 1736 the Jesuit Du Halde describes how the Emperor's physician at the Court in China treated him successfully with "Hia Tsao Tong Tchong". Du Halde mentions the fact that it is hard to "procure" and that its value is four times its weight in silver. It can be taken as a food ingredient, traditionally as a stuffing of duck, chicken or pork, as a soup ingredient, or ground up. *Cordyceps* tastes agreeable and I would describe it as primarily fungal without much difference in taste between the fruiting body and the former body of the larva. The recommended daily dosage is 3-9 g (Yao & Zhang, 1996), which would cost about 75-350 RMB [$9-$43] in 2003 retail prices, making it an extremely costly treatment. In general chongcao is used as a tonic in TCM to strengthen the system and regain energy, somewhat similar to the tonic functions of ginseng (*Panax* spp.). Liu (1994) summarizes chongcao's healing capacity as a tonic to enhance vitality. Its main TCM applications are for treating exhaustion, TB, asthma, back pain and reproductive issues (i.e. premature ejaculation). Its use as an aphrodisiac seems to be the driving force with male consumers in China, a fact Tibetan informants liked to comment on, pointing out that they have no need to take *Cordyceps*. The development of new drugs addressing erectile dysfunction might reduce the demand for *Cordyceps*[5].

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[1] Some Tibetan scholars recognize *da byid* as another name for yartsa gunbu (pers. com. Mingkyi Tsomo, 2004). This recognition is based on Gawa Dorje's (*dGa' ba'i rdo rje*, 1995) recent work, who mentions *rtswa da byid* as another name for yartsa gunbu. This identification is controversial. However, *da byid* is already mentioned in the ancient Gyu Zhi (*rGyud bzhi*), the "Four Tantras" (*g.Yu thog yon tan mgon po*, 2002), which were composed between the 8th and 11th Century, laying the theoretical basis for Tibetan medicine. If this controversial identification can be substantiated, the first *Cordyceps* reference could be over a thousand years old.

[2] Similar beliefs prevented Tibetans from mining gold in the past. Since most Tibetans would not mine gold, this encouraged lowland Chinese to come and exploit these resources. However, this situation has changed recently and Tibetans are getting involved in mining if not priced out by extremely costly mining licenses issued by County governments.

[3] Lithang had a small Chinese garrison since 1720, but direct Chinese control was not imposed until 1906, when General Zhao Erfeng's armies quelled the 1905 rebellion in Kham against Chinese rule (Adshead, 1984).

[4] There is a recent claim (Halpern, 1999) that *Cordyceps sinensis* was already mentioned in TCM texts from the Tang Dynasty (8th Century). However this claim could not be substantiated.

[5] Luckily these new drugs also might ease the pressure on the dwindling wild populations of tiger and rhinos commonly used for virility issues in Chinese communities.

MYCOLOGY: *CORDYCEPS* AND ITS HOSTS

Cordyceps is an entomophagous (feeding on insect) flask fungus (Pyrenomycetes, Ascomycotina) in the family Clavicipitaceae[6]. There are 300 to 400 species of *Cordyceps* (Sung, 2004), of which 68 species have been recorded in China (Wang, 1999); 33 species have been recognized in the Tibetan Plateau and Himalayan region (Zang & Kinjo, 1998). *Cordyceps* species parasitize insects, spiders, and sometimes deer truffles (*Elaphomyces,* a hypogeous ascomycetous fungus). Only a few are collected for their medicinal properties. Most commonly used among these is *Cordyceps sinensis*. Several other species are also referred to as chongcao in TCM, such as *Cordyceps militaris*, which is widely distributed in North America and Eurasia (Arora, 1986), as well as *Cordyceps ophioglossoides*, *C. sobolifera*, *C. liangshanensis* and *C. cicadicola* (UNW, 1996). However, no other species is considered as powerful as *Cordyceps sinensis,* or is as costly (Chen *et al.*, 2002). Zang & Kinjo (1998) have described several distinct species so far clustered under *C. sinensis*: *C. gansuensis*, *C. kangdingensis* and *C. nepalensis*. In this article *C. sinensis* will be used *sensu lato*. There will be no further differentiation of *C. sinensis* from the apparently very similar newly recognized alpine species.

Cordyceps sinensis (Berk.) Sacc. parasitizes a range of grass root-boring caterpillars, which would hatch as whitish ghost moths, when not attacked by *Cordyceps*. The normal reproductive cycle for *Thitarodes* (*Hepialus*) takes up to five years; most of the life cycle is lived as a caterpillar, the moth itself living for only a short time, 2-5 days in the case of *H. biruensis* (Chen *et al.*, 2002). As many other ghost moths, the adult *Thitarodes* moth is not able to eat. So far, the host for *C. sinensis* most commonly reported is *Thitarodes armoricanus* (Oberthür) Ueda, Hepialidae, Lepidoptera. Other host larvae have been identified, such as *Hepialus oblifurcus* Chu & Wang (Gao *et al.*, 1992), *H. baimaensis* Liang and *H. biruensis* Fu Huang & Chen (Chen *et al.*, 2002). All in all, nearly 40 species of *Thitarodes* (*Hepialus*) moths are recognized in the Tibetan Plateau region and, according to Chen *et al.*, 30 species can be infected by *Cordyceps sinensis*. Chinese entomologists are still using the generic name *Hepialus*, although it has been restricted to a single European species – *Hepialus humuli* – for some thirty years. The genus *Thitarodes* was erected in 1968 to accommodate *Hepialus armoricanus* and other related species placed originally in *Hepialus* (Nielsen *et al.*, 2000), many of them the host for *Cordyceps sinensis*.

Fig. 1 - Map of the Tibetan Plateau region and the distribution area of *Cordyceps sinensis sensu lato*. The distribution area is based on multiple sources including CAC 1990 and Atlas of Tibet AR 1996.

[6] Clavicipitaceae also contain *Claviceps purpurea* – wheat ergot, from which lysergic acid is derived (Arora, 1986). It is interesting to note that *Cordyceps ophioglossoides* is used by indigenous healers as a neurotropic in Mexico (Guzman *et al.*, 1998).

Kendrick (1992) reports that *Cordyceps* fungi have developed a special adaptation to improve their chances of reproductive success. Since reproduction is dependent on a very specific host, each spore fragments into 100 or more part-spores so that each fungal fructification produces 32 million propagules, thus increasing the odds of landing on a larva. Li *et al.* (1998) report that *Cordyceps sinensis* produces 30-60 propagules, and that usually 15 days pass between spore dispersion, their breaking up into propagules and larval infection. The propagules usually attach themselves to the larval state of the insect, but they also can attach themselves to mature moths as well. Apparently the larvae is forced by the fungus to move into its final position before being immobilized, since the fungus needs proximity to the surface to grow its fruiting body (stroma) above ground. Not infected larvae will not hibernate close to the surface. The mycelium – a cotton-like mesh composed of white threads (hyphae) – develops inside the body of the insect, first feeding on less vital parts, until it has taken over the complete organism filling the caterpillar with its hyphae. After the insect is completely mummified and emptied of nutrients, leaving behind the larval exoskeleton filled with the *Cordyceps* mycelium, the fungus will develop a fruiting body out of the head above the eyes, where the larvae has a horn-like protuberance in early spring. The 5-10 cm long, brown, club-shaped fruiting body grows above ground to have its propagules dispersed by the wind in order to find a new host insect. The stroma is nearly twice as long as the caterpillar when fresh (Fig. 2 and 3). It takes several weeks for the spores to mature. As the insect is the sole source of food for the fungus, the size of its stroma is dependent on the size of the host caterpillar (Arora, 1986). Fruiting of *Cordyceps sinensis*, according to collectors in Lithang, is enhanced by high precipitation – plateau winters are arid and frigid – and by mild temperatures in spring. However, as Boesi (2003) reports, if too much snow accumulates during the harvest season the stromata will rot and much of the harvest is lost. While most other commonly collected mushrooms, many of them living in ectomycorrhizal symbioses with trees, fruit in clusters, *Cordyceps* does not fruit in groups, but is highly dispersed, since each individual fungus is feeding on a different larva. However, specific site conditions might contribute to a concentration of larvae and thus of fruiting bodies.

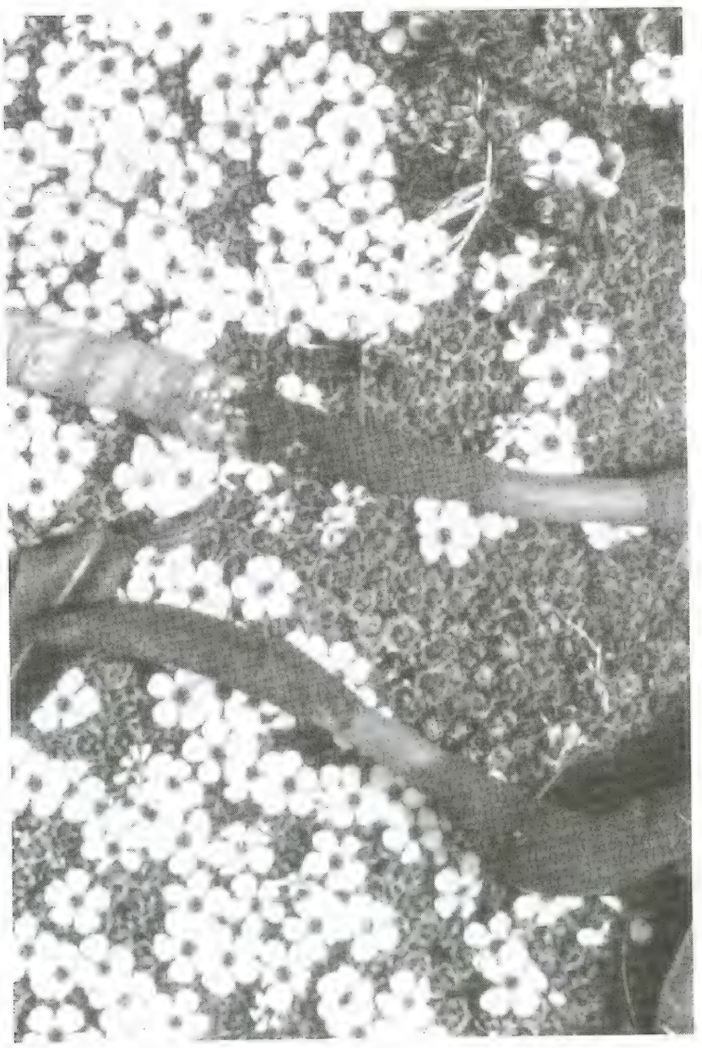

Fig. 2 - *Cordyceps sinensis* freshly dug and partially cleaned laying on *Arenaria*. Note the caterpillar base and the well-developed asci at the top of the stroma. Photo: D. Winkler, June 26, 1997, Bachen County, 4,400 m, Tibet AR.

Fig. 3 - *Cordyceps sinensis* freshly exposed *in situ*. Note the asci have not developed at the top of the stroma and thus this specimen is being harvested before it can produce propagules (=spores). Photo: D. Winkler, April 24, 2004, near Gye La, 4,000 m, Kangding County, Kandze TAP, West Sichuan.

DISTRIBUTION AND ECOLOGY

Cordyceps sinensis is endemic to the Tibetan Plateau including the adjoining high altitude areas of the Central and East Himalayas (Nepal, Bhutan and India's Uttaranchal, Sikkim, Himachal and Arunachal Pradesh). In addition, Zang & Kinjo (1998) also report *C. sinensis* from the Tian Shan and Altai Shan in Xinjiang, NW China. However, there is also abundant misleading information available regarding the distribution of *Cordyceps sinensis*, which is explained by the fact that TCM's chongcao includes a range of other *Cordyceps* species. Countless webpages list Guizhou, Hubei, Zhejiang and some other Chinese provinces; this might be quoted from "Icones of Medicinal Fungi from China" (Ying *et al.*, 1987), which also misreports *Cordyceps sinensis* growing in marshlands. *Cordyceps sinensis* is common in grasslands and shrublands of the Tibetan Plateau including West Sichuan, North Yunnan and vast areas of Tibet AR, Qinghai and West Gansu (see Fig. 1). Its distribution is limited to areas with an average annual precipitation above 350-400 mm. In general, *Cordyceps* is not found in areas where precipitation is below 300 mm/a, such as the Changtang and other arid areas of the northwestern Plateau.

The grasslands providing habitat for *Thitarodes* (*Hepialus*) moths and thus for *Cordyceps sinensis* consist predominantly of *Kobresia* sedges. *Kobresia* can cover up 80-90% of the subalpine grasslands (Wu, 1997a). According to Miehe *et al.* (2004), *Kobresia* pastures of the Tibetan plateau are the world's largest alpine ecosystem covering 450,000 km^2 with an altitudinal range from 3,000 m to nearly 6,000 m gradually rising from the southeast to the northwest of the Plateau. In general *Kobresia* pastures are dominated by these *Kobresia* species: *K. capillifolia, K. humilis, K. pygmaea*, and *K. schoenoides*. The dominance of *Kobresia* in plateau grasslands seems to be a result of intensive grazing (ibid.). Aside from *Kobresia* sedges, a range of grasses and a great variety of forbs are common. For dominant species in Lithang see Table 1. Zang & Kinjo (1998) report that alpine *Cordyceps* species associate with *Polygonum affine*, *P. viviparum*, *P. macrophyllum*, *P. glaciale*, *Astragalus balfourianus* and *A. craibianus*. Chen *et al.* (2000) state that *Thitarodes (Hepialus)* prefers to feed on young roots of plant species of the families of Polygonaceae, Fabaceae, Cyperaceae, Poaceae and Liliaceae. Its favorite fodder species in Nagchu are *Polygonum viviparum*, *Rheum pumilum*, *Astragalus yunnanensis* and *Salix lindleyana*. Here in good habitat an average density of 0.42 specimen per m^2 is reported, but it can reach 4 specimens per m^2.

Tab. 1 - Typical species in subalpine grasslands (3,800-4,800 m, ≈800 mm precipitation/a) including shrubs in Western Sichuan (Sichuan Zhibei, 1990; Wu, 1997b).

Sedges and Grasses	**Forbs**	**Shrubs**
Kobresia setchwanensis,	*Potentilla anserina, Anemone rivularis,*	*Spiraea schneideriana,*
Kobresia pygmaea,	*Astragalus* spp., *Primula sikkimensis,*	*Spiraea myrtilloides,*
Kobresia kansuensis,	*P. prattii, P. secundiflora, Aconitum rockii,*	*Spiraea alpina,*
Poa elanata,	*Gentiana veitchiorum, Polygonum viviparum,*	*Ribes glaciale,*
Poa gracilior,	*Rheum alexandrae, Nardostachys chinensis,*	*Potentilla fruticosa,*
Ptilagrostis dichotoma,	*Ligularia* spp., *Pedicularis* spp.,	*Caragana jubata,*
Festuca rubra,	*Cremanthodium campanulatum, Leontopodium*	*Lonicera hispida,*
Festuca ovina,	*franchettii, Aster batangensis, Saussurea stella,*	*Lonicera thibetica,*
Deyeuxia scrabescens	*Anaphalis flavescens, Meconopsis horridula,*	*Berberis approximata,*
	M. integrifolia, Lancea tibetica, Saxifraga	*Rhododendron litangense,*
	montana, Rhodiola dumulosa, Fritillaria	*Rh.* spp.
	cirrhosa, F. przewalskii, Allium beesianum	

Caterpillar fungus thrives in subalpine and alpine grasslands or meadows as well as open dwarf scrublands around the potential treeline. Based on the potential treeline, a relatively well-researched geo-ecological indicator (i.e. Li, 1994; Miehe, 2004) assessment can be made regarding the altitudinal distribution range of *C. sinensis*. It is distributed within a range of 400-500 m of altitude to the potential treeline. Basing the distribution on the potential treeline is helpful, since the current actual treeline has been strongly influenced by human activities. Wide areas of the Tibetan Plateau forests have been replaced by pastures through the millennia, see Winkler (1998, 2000).

Tab. 2 - Altitudinal Distribution of *Cordyceps sinensis* in correlation to the potential treeline on the Tibetan Plateau.

Area	Distribution of *Cordyceps sinensis*			Potential Treeline
	Lower Limit	Upper Limit	Source	
Ganzi TAP (Sichuan)	3.500 m	4,700 m	Liu, 1994	3,800 - 4,400 m
Lithang, Ganzi TAP (Sichuan)	3,800 m	4,800 m	Winkler	4,200 - 4,400 m
Qamdo Prefecture (Tibet AR)	4,300 m	5,000 m	dGa' ba'i rdo rje, 1995	4,400 - 4,600 m
Naqu Prefecture (Tibet AR)	4,100 m	5,000 m	Chen, Yin *et al.*, 2000	4,400 - 4,600 m
Bhutan	4,070 m	4,800 m	Namgyel, 2003	3,800 - 4,000 m
Kumaon Hills, Uttaranchal, India	3,300 m	4,300 m	Arif & Kumar, 2003	3,600 - 3,800 m

In Lithang, caterpillar fungus is mostly found on north-facing slopes according to Boesi (2003). Pastures on north-facing slopes – all grasslands are grazed at some point through the year – usually retain more moisture through the arid winter months, since snow will not melt and/or evaporate as quickly as on south-facing slopes. In Machen (Maqen) County (Golok/Goluo Prefecture) and other Counties of South Qinghai Province and NW Aba TQAP, *Cordyceps* proliferates on well-drained sunny slopes with lush grass vegetation (pers. com. Toni Huber, 2004). In Nagchu Prefecture (Tibet AR) *Cordyceps* is confined to rich pastures and absent from marginal areas. Also, sites which are too wet or waterlogged, such as bogs and tussock grass areas, do not have *Cordyceps* populations.

YARTSA GUNBU HARVEST

Each year, when spring arrives in the grasslands, Tibetan nomads, farmers and also some city dwellers, venture on foot or on horseback out into the grasslands to look for "bu", as Khampas and other Tibetans call it for short. At lower elevations the season can start as early as mid April, but in many places not before the beginning of May. In colder high altitude areas, such as in Bachen or Biru County, Nagchu Prefecture, it lasts into July. The collection peak phase should not last longer than 6 weeks in a given area. The present decentralized grassroots gathering (no pun intended) is very efficient. Some people are concerned it might be too efficient and there are concerns regarding its sustainability (see below). The harvest procedure itself is simple; collectors usually carry a small hoe or use their knife to lift the caterpillar fungus out of the fertile topsoil. This needs to be done carefully, since the *Kobresia* turfs are very dense and breaking off the stroma from the head of the larva reduces the value.

The actual gathering of yartsa requires an intensive but extensive search. The grasslands and shrublands are vast and the visible part of the fungus is very small, often not longer than 2-5 cm. It can be spotted only at close range[7] and individual yartsa are dispersed, not like many other fungi whose mycelia may produce several fruiting bodies close together. A daily harvest in Lithang's grasslands is anywhere from a few specimens to several dozen specimens, sometimes up to 100 specimens per collector. In high season a common average seems to be around 20 to 40 specimens per collector per day.

During yartsa season Tibetans focus on gathering, and keep other activities to a minimum, since the income generated is very important. Consequently, during peak season, it is difficult to carry out labor-intensive projects. Community or government infrastructure projects, such as local road construction, come to a halt. Finding local workers for reforestation can become difficult. To attract workers wages need to exceed the potential income from gathering, often a multiple of common wages. However, since the mushroom hunt also includes the risk of finding very few specimens, some people prefer a guaranteed income, as I was told by locals working in reforestation in Lithang. In some areas schools give vacations, so that students can join in collecting. For example, in adjoining Nyarong County (Pinyin: Xinlong, Kandze/Ganzi TAP) most schools close for 20 days in late May (pers. com. Pam Logan, 2002) and also in Beizha, Nangchen County (Nangqian, Yushu TAP, Qinghai), the Gar Monastery school scheduled their month-long vacation period to coincide with the yartsa gathering season (pers. com. R. Harris, 2004). Even attendance at traditional festivals, such as Cham dances in Songpan (Aba, TAP), suffers from people collecting "bu" in the grasslands instead of joining the celebration (pers. com. Mona Schrempf, 2004).

In Lithang's Junba District communities live and farm in deep, forested valleys (Tibetan: *rong*), but graze their livestock above treeline on the grasslands (*thang*) in summer. In spring often most members of a household camp out in the grasslands (Fig. 4 and 5) without livestock, turning the hunt into a joyful event. Also, some people set up tents around collectors' camps to serve as shops or

[7] In April 2004, when looking for yartsa gunbu in Kangding County near Gye La at 4,100 m, one phrase came to my mind again and again 'looking for a needle in a haystack'. Actually, the odds of finding the tiny brown stromata, which grow around aromatic small purple-flowered rhododendrons of the Lapponica subsection, seemed stacked against us. In 3 hours, two experienced Tibetan friends and I found 3 "bu" (worms). This site was apparently not a prime collection area.

bars, thus taking their share from the freshly made *Cordyceps* money. In Chungba (Junba) I was told that collectors are confined in collecting to their legal grazing grounds. Collectors from outside reported that they had to pay a flat fee of 25 RMB ($3) per collector to the administration for the 2001 season in Chungba District. However, in Lithang, grasslands are in general perceived as openly accessible for collection of plants and fungi. Local herders do not own their pastures according to Chinese law, but have usage rights. Exploitation of resources on common property often causes disputes. Although in Lithang and Sershul (Serxu/Shiqu) many collectors complained that there are too many people collecting nowadays, no informant reported violent conflicts during yartsa collection. Also Boesi (2003), who carried out a detailed study of the yartsa harvest in Lithang, reports that "cropping activities are not controlled by any particular local rules or traditions, there is no competition between the gatherers of the produce (*'bu rko ba*), either they are recurrent or occasional labourers or they come from different villages to exploit the produce. Nobody claims the right to pluck over a certain area".

Fig. 4 - A family camping out in the grasslands to collect yartsa gunbu. Light snow fall is not uncommon during the season. Photo: D. Winkler, May 2, 2000, Lithang County, 4,450m, Kandze TAP, West Sichuan.

Fig. 5 - Yartsa gunbu hunter camp at Chungba (Junba) La in Lithang County. Photo: D. Winkler, May 1, 2000, Lithang County, 4,200 m, Kandze TAP, West Sichuan.

HISTORY OF TRADE

Many early western explorers of Eastern Tibet (Rockhill, 1891; Pratt, 1892; Bacot, 1912; Wilson, 1913) reported on the collection and the trade of caterpillar fungus from Tibet to China often in exchange for tea or luxury goods like silk, confirming its economic importance. Bailey (1945) brought to the west the first photo of yartsa collection taken in Lithang in 1911. Shelton (1921), a missionary who spent 17 years in Batang wrote: "Wonderful and awe-inspiring concoctions of Chinese medicine contribute much to the industries of the Tibetans. [..] In the spring and summer months Tibetans also dig plants and collect fungi and other articles of supposed medicinal value for export to the Chinese market. One of the ingredients is the grass worm. [..] This seeming combination of animal and vegetable life is not only used as a medicine, but is also eaten as a delicacy". Coales (1919) reported on trade in "Tachienlu" (Pinyin: Kangding, Tibetan: Dardsendo) "the medicines exported are mainly rhubarb and other vegetable drugs for the Chinese market. The most interesting is the curious Chungtsao or insect grass, a dried caterpillar about 2 inches long, which has been killed by a fungus of about the same length growing out of one of its segments. It is supposed to be an excellent restorative to weak constitutions". Yartsa traditionally and still today functions as currency in many areas. It is a favorite trading good, since it is small and light-weight (<1 g), it does not readily deteriorate, and is very valuable.

Historically 60% of China's chongcao supply came from the Tibetan areas of Sichuan (Liu, 1994). Already during the late Qing dynasty (1796-1874) 10 t of yartsa gunbu were exported annually from the Kham[8] region when trade between China and Tibet blossomed (Wang, 2000). Statistics for Sikang (Pinyin: Xikang), a former province (1920s - 1961) comprising most of the Tibetan cultural area of Kham list chongcao production at 15 t in 1939; at that time 1 kg was worth 8 Yuan. In 1953/4 in Kandze/Ganzi Prefecture alone, there was an output of 10 t. According to the Ganzi Mushroom Institute in Kangding the highest annual production in Ganzi TAP[9]

[8] More or less today's Sichuan's Ganzi TAP, Tibet AR's Qamdo Prefecture, NW Yunnan's Deqen TAP and Qinghai's Yushu / Jyekundo TAP.
[9] In Ganzi TAP there are four main 'production' areas: Sershul (Serxu, Shiqu), Lithang, Kandze (Garze/Ganzi) and Sertar (Serta, Seda) (Liu, 1994). These are all Counties with vast grasslands.

was 20 t. During the Cultural Revolution and the Commune phase the chongcao market cooled off, but it resumed with the economic liberalization in the early 1980s. In 1982 prices were still very low: one specimen cost 0.1 RMB or 200 to 250 RMB per pound in Lithang. In Chengdu 1 jin (500g) was traded for 400 to 500 RMB. The overall production of *Cordyceps sinensis* is estimated at nearly 100 t per year in all of China according to an unpublished Chinese industry report.

THE PRESENT *CORDYCEPS* MARKET

Since economic liberalization in the early 1980s, caterpillar fungus has developed into one of the most important "cash crops" on the southeastern Tibetan Plateau. Since caterpillar fungus is consumed dried and not fresh, there is no need for rapid marketing as with culinary mushrooms. Its small size, its easy preservation, and its high value make transport very easy. Furthermore, dried specimens often fetch much higher prices in winter. Lack of cash and fluctuating prices deter most people from holding back their harvest and speculating on profits to be made by selling in winter. However, yartsa is also used as a way of keeping savings at home.

Cordyceps is traded in several categories; the main criteria are water content (fresh, dried), state of processing (uncleaned, cleaned) as well as size, the main retail price factor. The fungus becomes more valuable with increased cleanness and dryness. Freshly harvested caterpillar is encased in a black topsoil layer. The coating is first opened by hand or commonly with a toothbrush. Careful brushing exposes the caterpillar's body; the stroma itself is not encased in soil. It is important not to break off the stroma during cleaning. Broken specimens lose value; sometime a piece of match is used to reconnect the broken-off stroma. After cleaning, specimens are dried again, often on paved sidewalks or side streets in Lithang (Fig. 6). Also of importance is the origination of the *Cordyceps*. Dealers in Chengdu's Hehuazi market distinguish between origin from Tibet AR, Qinghai and West-Sichuan. However, the differences seem to be based mostly on size, not medicinal qualities per se. Tibet AR, especially Biru and Tengchen, is known for growing the biggest specimens. Those from Qinghai and West-Sichuan fungi are both smaller and regarded as being similar in quality.

Fig. 6 - Yartsa gunbu dealers sitting around a small pile of drying *Cordyceps* in Lithang town. Photo: D. Winkler, June 5, 1999, Lithang County, 4,010 m, Kandze TAP, West Sichuan.

After collection most caterpillar fungus is usually first marketed in the local administrative center or directly in the County seats or other important market towns. In remote areas in Lithang, prices are 5% to 10% lower than in the County seat. For example, in 1999 in Chungba (Junba) town 1 jin (= 1 metric pound = 500g) was sold for 1,300 RMB. In Lithang town, 6 hours away by jeep, the same bunch would fetch 1,400 RMB. Asked about selling their harvest in Kangding or Chengdu informants from Lithang said that the prices are fluctuating and the extra input of time does not justify taking the risk.

Some collectors clean their mushrooms themselves; others sell their uncleaned fungi to local dealers, who will hire locals for cleaning before reselling. Prices nearly double for the same amount of specimen after cleaning due to the weight loss incurred during cleaning. Cleaned fungi are bought up by middlemen, whose average acquisition from collectors is 250 g to 1 kg at around 1,500 RMB per jin. Local dealers often do 10 to 20 such transactions per day, which would require a capital of 3,000 to 30,000 RMB. Many of these dealers also trade other medicinal plants or matsutake mushrooms in the summer. All of these transactions take place on Lithang's main streets. The whole area is buzzing from the fungi deals (Fig. 6). Regular shopkeepers are not involved in the trade. Sellers from the most remote areas in Lithang and adjacent Counties are in town to sell off their fresh harvest, be it from a couple of days hunting or from 6 weeks of work. Dealers with scales, which signal their interest, walk up and down the streets to attract the next deal or they simply hang out on a chosen spot waiting for sellers to come by. Prices are being discussed constantly, but are relatively stable. However, prices usually change through the season on the basis of supply and demand. Sellers, flush with cash, use their visit to town to buy staples or luxury goods and enjoy their windfall in fancy restaurants.

The daily quota of the middlemen, mostly Tibetans and also Hui[10], was estimated by informants at 1 to 5 kg, is later bought up by big dealers, many of them lowland Chinese or Tibetans, for South Chinese phytopharma companies. These transactions do not take place on the street. Several middlemen estimated that there are about 100 dealers buying up small quantities from local collectors. This information allows a rough estimate of a daily transaction of 100 kg to 500 kg in Lithang Town. For a 6-week caterpillar fungus season this would indicate that 4.5 t - 22.5 t of *Cordyceps sinensis* is traded annually in Lithang. However, the higher end seems clearly too high a guesstimate. Dealers and officials interviewed estimated the annual harvest at between 5 t and 10 t (value: 7.5-15 million RMB), however one yartsa dealer was convinced that Lithang annually produces only about 1t, but local trades included another 1-2 t collected in neighboring Counties. All in all, these figures compare well with official figures from Kandze TAP's Derge County, which reports an annual production of *Cordyceps* of 3 t (Derge County statistics, 1997). Tengchen County (Denqen / Dingchen, NE Qamdo Prefecture, Tibet AR) is reported to annually trade up to 7,5 t, which provides 60% of Denqen's GDP (CTI, 2003). Chen *et al.* (2000) report from Naqu Prefecture (Tibet AR) that the annual yield of *Cordyceps sinensis* is 7 t. There, yartsa mostly grows in the relatively warmer and moister southern Counties, such as Diru (Biru), Drachen (Bachen/Baqin), Sok (Suo), Lari (Jiali), Nyanrong (Nierong), and Nagchu (Naqu) of Nagchu/Naqu Prefecture.

MARKET PRICES

During our two-week stay in Lithang in May and June 1999, prices were relatively stable. Individual specimens were traded for 1 to 5 RMB depending on size, the bigger the fungus, the higher the price. The price of the biggest specimens increased from 4 RMB to 5 RMB through this season. 1 jin (500 g) unsorted wet & cleaned yartsa was sold for 1,400 to 1,500 RMB, which indicates about 800 to 1,000 specimens per kg. Prices in 1999 were substantially higher than in 1998, when 1 jin wet & cleaned yartsa sold for only 900 RMB. In 1997, the price was much higher at 2,000 RMB/jin for cleaned fungi.

Tab. 3 - Fresh Caterpillar fungi prices in Lithang Town between 1997 and 2004.

Year	1997	1998	1999	2000	2001	2002	2003	2004[11]
RMB/jin	1,800-2,000	800-1,000	1,400-1,800	1,700-2,000	4,500-7,000	8,000-12,000	8,000-20,000	9,000-15,000

The degree of dryness of yartsa is an important factor when basing the price on weight. Dealers assess the moisture content by the flexibility of the fungus; the less pliable the fungus, the dryer it is. At Chengdu's Hehuazi market, China's biggest medicinal plant market, informed dealers stated that 3.5 jin of fresh wet fungi will weigh 1 jin when completely dry. This would indicate a weight reduction of 71.5%[12]. Using this formula, if 1 jin of fresh,

[10] Huis – Chinese Muslims – travel all over the Tibetan areas of Qinghai and Sichuan buying up *Cordyceps*, medicinal plants, gold and yak hides, the latter a trade supposedly completely controlled by Hui dealers. Also many shops are owned by Huis in Kham and Amdo.
[11] These prices are from late April 2004, the very onset of harvesting season.
[12] Fungi usually lose 75-85% of their weight when dried.

wet and clean chongcao costs 1,500 RMB in Lithang, 1 jin of dried chongcao would elsewhere cost 5,250 RMB plus transportation cost and profit margins. However, even relatively fresh fungi will have lost some moisture when coming onto the market, especially when collectors sell off the harvest of a month's search. Figures in Table 4 support the trend of this formula. Dealers at Chengdu's TCM market add about 1,000 RMB to each jin. Overall, what seems like a steep increase in prices from Lithang's 1,300-1,500 RMB/jin to Chengdu at 7,000-8,500 RMB/jin mostly evaporates once moisture content is taken into account.

In Hong Kong in October 1999, 37.5 g of packed bigger specimen cost 528 HK$, small ones sold for 480 HK$. This indicates a retail price of 7,125 to 7,750 RMB/jin. A former chongcao dealer reported that in 1992 1 jin of dried & cleaned fungus cost 1,800 RMB in Kandze Prefecture. In Guangdong, the same jin was worth 2,250 RMB, which is an increase of value of 25%.

Tab. 4 - Caterpillar fungi prices in Lithang Town and at Chengdu' s Hehuazi Market in May and June 1999.

Market Location	**Type of *Cordyceps sinensis***	**Acquisition per jin in RMB**	**Selling per jin in RMB**	**Specimen per jin**
Lithang Main street	wet, uncleaned, unsorted	700 - 800	800 - 900	200 - 300
	wet, cleaned, unsorted	1,300 - 1,400	1,400 - 1,500	400 - 500
Chengdu Yaocai Market	dry & small	6,000 - 8,000	7,000 - 8,500	1,400 - 1,800
	dry & biggest	7,000 - 10,000	12,000 - 13,000	1,000 - 1,200

Prices clearly fluctuate through the years, especially depending on the annual harvest. Seasonally, the prices are at their lowest in harvest season in spring and peak in winter, since there is much less product available, but this is also partly caused by the much lower water content of *Cordyceps* so long after harvest season. Thus, winter prices are better compared to the markets in the lowlands, which trade mostly in completely dried fungi. In the winter of 1997/98 the price was at 6,000 RMB/jin for fully dried caterpillar fungus. In Chengdu 1 jin of big chongcao can cost up to 18,000 RMB, small ones to over 10,000 RMB/jin. Here seasonal price changes have a range of 30% to 40%, the price of bigger specimens being more susceptible to fluctuation. Dealers would like to buy several hundred pounds in Chengdu, but going to the production areas is too risky. The fluctuation of prices makes it too uncertain. Some dealers go to Kangding to purchase fungi, but there are not enough fungi available. One has to go further, to the Counties of origin. Overall, the inflation of the price of *Cordyceps sinensis* is very impressive. While one jin (500 g) of average yartsa was available for 200-250 RMB in Lithang in 1982, twenty-one years later one jin fetched from 8,000-20,000 RMB, which is a price increase of 40 to 100 times. Recent dramatic price increases are reported by some as a result of the SARS epidemic in China in 2002, since people apparently believed that *Cordyceps* would help prevent infection with SARS.

ECONOMIC IMPORTANCE

The income derived from yartsa gunbu is very important for Lithang[13] and all the other areas of Tibet where *Cordyceps* occurs. Resource control, be it usage rights or ownership, is crucial factor in accessing and developing economic plant and fungus resources. Unlike many other natural resources in the region, such as timber, gold and also increasingly hydroelectricity, where the profits are captured by the state sector, fungal income (and other income from wild collected plants) goes directly to rural households. There are three main factors that enable rural households to participate successfully in accessing this resource; open access of the grasslands, availability of harvesting knowledge, and no capital required for participation. Thus, resource access is assured to the people, who are otherwise marginalized by government control of local resources such as timber, by lack of formal education, lack of access to credit, etc. Thus, almost all rural households, who base their survival on traditional subsistence herding and agriculture, participate in yartsa gunbu collection (see also Winkler, 2003). Table 5 shows the *per capita* value derived from yartsa gunbu harvest in Lithang.

[13] Research between 1999 and 2002 was carried out during consulting work for The Bridge Fund, San Francisco. Special thanks to my co-workers Huadan Zhaxi and Mick Rigdrol.

Tab. 5 - Annual *Cordyceps sinensis* harvest and income generated in Lithang in 1999[14].

Estimated harvest	Fungus specimen	Total value in RMB	RMB per household	Harvest *per capita*	Specimens *per capita*	Specimens per ha grassland
1 t	900,000	2,700,000	325	20 g	23	1.5
5 t	4,500,000	13,500,000	1,626	102 g	113	7.6

These figures are impressive. For comparison, in 1993 the gross value of industrial and agricultural output in Lithang County is reported at 67 million RMB, including an agricultural output of 47 million RMB. Checking these figures back, by extrapolating Lithang's Chungba (Junba) District figures from 1998, where *Cordyceps sinensis* and the booming matsutake mushroom (*Tricholoma matsutake*) collection contributed 60% to the District income of 959 RMB *per capita* in 1998 (com. District leader, 2000), in Lithang County this would figure to around 40 million RMB while the official GDP figured at 107.4 million Yuan in Lithang in 1998[15]. However, much of the income derived from the mushroom industry apparently is not accounted for in official statistics. Underreporting of earnings reduces tax burdens and secures provincial and/or central subsidies and thus is a widespread phenomenon in rural China.

The importance of yartsa for rural households has been confirmed in many other locations. In connection with rural development project development, I have also interviewed local people in several Counties in Kandze TAP, such as Nyarong (Xinlong), Sertar's Golok (Seda) area, Sershul (Shiqu) and Derge (Dege). Unless people have access to precious non-timber forest products such as matsutake and morels, caterpillar fungus typically contributes 50% to 80% of the annual household cash income.

FUTURE MARKETING

The marketing mechanisms seem very evolved for a trade in such a remote region. The fact that the price between remote villages and Lithang's County seat differs by only about 8%, without deducting minimal transport cost, indicates an established marketing network. However, the network is informal with fluctuating prices, thus adding some uncertainty, which deters many dealers from getting involved in long distance trading. Only a few people occupy this niche, since trading in bigger quantities requires large amounts of capital. Even local dealers, buying a daily quota of 20 jin require a capital of 30,000 RMB, which exceeds 5 years' salary for an average government worker. The fungal trade, especially caterpillar fungus and matsutake, has helped to generate local capital that allowed some local dealers to finance jeeps and other vehicles. The informality of the sector is further illustrated by the fact that there is no real taxation, as one informant put it, "you need to get caught with a truck load at a check point", and that governmental statistics seem to not fully include the caterpillar fungus trade in their statistics.

Furthermore, Lithang and many other Tibetan localities need to establish their own brands of chongcao and raise its profile as a distinct geographic origin of medicinal fungi. Preparing a product ready for marketing would surely increase local profit margins and create job opportunities. In Lithang, there is already a distillery that produces liquor (qingke jiu) from regionally grown barley with a few caterpillar fungi or fritillary bulbs (*Fritillaria* spp., beimu) floating in the bottle. Having processing and packaging companies in Lithang will be an important step in securing sustainability, since reduction in local output would be felt directly by the companies. In addition, higher profit margins are captured locally and employment opportunities created. Moreover, once this process is initiated and gains momentum it can be applied for many other precious medicinal resources.

ARTIFICIAL AND SEMI-ARTIFICIAL *CORDYCEPS* CULTIVATION

Chinese laboratories pioneered artificial cultivation of *C. sinensis* derived organisms in the early 1980s. The resulting asexual organisms are distinct from *C. sinensis* and since the fungus is not parasitizing *Thitarodes* caterpillars, but feeding on other substrates, the organism develops differently, and thus is regarded as a different species. There are many new species, known as agamotypes, i.e. *Paecilomyces hepiali*, *Hirsutella sinensis*, and *Cephalosporium donchongxiacae* (Wang *et al.*, 1998). In China, liquid culture or fermentation is widespread. Tanks containing a liquid medium formulated to optimize mycelial growth are inoculated with a *Cordyceps* derived agamotype. Sterilized silkworm residue is commonly used as base for this medium. In America and Japan

[14] Figures in this table are based on a total of 44,336 inhabitants (1995) with 5.35 persons per household (Ganzi TAP average for Tibetan Households in 1990), 595,000 ha grasslands, at 450 *Cordyceps* specimen per 500g/1jin.

[15] The average *per capita* income was 2,333 Yuan in Lithang in 1998. However, the *per capita* income of rural households was only 905 Yuan per person in Lithang, while the average *per capita* income of County employees was 8,094 Yuan.

unconverted grain substrates are frequently used in solid culture (Holliday *et al.*, 2004).

Cultivators like to advertise their product derived from the asexual propagation as "superior", since it is asexually reproduced under controlled laboratory conditions and thus its potency is supposed to be guaranteed. Also, medical research is carried out on the efficiency of these lab strains. A consistent product might be guaranteed, but this does not assure that these products contain the same range of active ingredients as the natural product. Many cultivated products do not even contain Cordycepin, a key active ingredient of *Cordyceps sinensis* (Holliday *et al.*, 2004). Thus, these widespread products need quality control. In addition, Asian consumers do value the fact that medicines are gathered from the wild. The plateau origin adds to the lure of the caterpillar fungus besides the curiosity of this "symbiosis" of insect and fungal world.

Wild fungi, as long as they are available, will probably not be replaced by laboratory produced fungal strains, but prices might be negatively affected. Artificially grown *Cordyceps sinensis* mycelium so far has not impacted the market of wild *Cordyceps* in Asia at all, as clearly documented in recent price increases. Western consumers prefer artificially grown products to the real organism, since Western culture lacks a tradition of appreciating edible insects.

There are also experimental semi-artificial *Cordyceps sinensis* growing programs under way in Tibet AR (Lhasa), Qinghai and West Sichuan's Kangding. In Kangding (administrative centre of Kandze TAP), for example, the *Thitarodes (Hepialus)* host larvae are bred, building on China's rich knowledge of silkworm breeding. About 100 larvae each are placed into shoe carton-sized plastic containers with lids, which are filled with grassland soil containing the tubers and roots of their favorite natural foods collected from the wild, as well as some other roots from cultivation. After two years spores of *Cordyceps sinensis* are inoculated and about 10% of the larvae are actually taken over by the fungus and grow stromata, reducing the natural growing cycle from 5 to 2 years. In April 2004, longish stromata were observable in many boxes. This was the first large scale fruiting, I was told, the culmination of 25 years of research[16]. In another experiment, in a field station near Kangding, bred larvae were released to their subalpine grassland habitat, but there no *C. sinensis* fruiting has yet taken place.

Artificially and semi-artificially grown fungal substance and fungus might prove to be extremely helpful to reduce future pressure on the natural resource, which surely will increase steadily with the growing availability of disposable income in China and ongoing discovery of *Cordyceps sinensis* by Western consumers and continued medical research with promising results.

CORDYCEPS IN GOLOK TAP

Although I have not researched *Cordyceps* in Golok TAP myself (I only looked into the issue in Golok areas in the north of Sertar County, Kandze TAP), I have collected information from researchers and informants. Golok TAP, South Qinghai Province, is an important production area for *Cordyceps*. In general, these reports portray a similar situation regarding collection, marketing and the economic importance for local communities, but contain one striking difference: the fact that thousands of non-local migrating Hui and Han would come into pastoral areas for digging. To give an idea of the number of outsiders involved in the collection, Goldstein (1996) reports from Sangrima (Xueshan) Township, Dari County, that 3,000 outsiders would come in to dig fungus for a fee of 700 RMB per person, while the local population numbered 1,031. In this case the fees were used by local authorities for pastoral development projects, which considerably improved the local pastoral economy according to Goldstein. Horleman (2002) reports: "it seems that [*Cordyceps*] resources are presently mainly exploited by Han seasonal migrants and not by the Golok pastoralists. The collectors have to buy a permit from the local authorities, which grants exclusive collection rights for certain sites. However, the pastoralists [..] receive only a small fraction of the collection fees, although they are the ones who suffer most from the grassland degradation caused by extensive digging. Most of the profit from the permits goes to the local authorities, that is, to the townships and to the villages and herders' associations." Horleman was told by officials that the permits can cost up to 10,000 RMB per season and that over 100,000 migrants are coming to Golok TAP, a number comparable to the overall population. How much a traditional taboo placed on digging yartsa (see above) had contributed to the fact that outsiders were encouraged by the administration to exploit these resources needs further research.

Informants and reports also have bitterly complained about the licensing approach, which not only deprived local herders of one of their most lucrative resources, but also left them stuck with degrading holes in their pastures. Outsiders often dig much bigger hoes and thus damage the turf more seriously. Not surprisingly, there are many reports of conflicts between local collectors and outside collectors in Golok. An informant from Jigdril County (Jiuzhi Xian), who financed his high school education with *Cordyceps* collection, reported frequently scaring away Han and Hui collectors, who had come up to this remote County for chongcao collection. Showing his long Tibetan knife, he cut the encounters short and for that day secured his resource without further discussion.

Overall, many Golokpas were not content with the licensing system and wished to exclude outsiders from

[16] Research on the ecology, reproduction and artificial cultivation of *Cordyceps sinensis* was included in PRC's 9th five-year plan [item 10-5] as a key science and technology development project. Thus central funds have been made available for *Cordyceps* research and these cultivation programs. In the case of the Kangding facility, private and central government funding enabled cooperation with experts from Chongqing University.

collecting. Horleman was told that the outside exploitation of medicinal "plant" resources was banned in 2000, but actual enforcement took several years. Costello (2003) reports that administrations finally halted license sale to outsiders in 2003. However, many outsiders are still coming for the season (pers. com. Mick Rigdrol, 2004). The popular demand for preventing outsiders from collecting is understandable taking Costello's (2003) observation into account: "most pastoral families especially the poorer ones make most of their cash income not from selling livestock products, but from digging yartsa. The number of yartsa an individual can find each season varies greatly by individual, but averages between 600 and 1,000. The price for an average yartsa varies both yearly and through the year, varying between 2-4 Yuan each[17]. For those who dig with even average success, the income from yartsa, supplemented with dairy products provides enough for a basic living". In addition, yartsa also provides income to local dealers. Costello observed that yartsa changes hands 5 times before leaving town. This might explain a common complaint that local collectors do not receive fair prices and that too much profit is made by middlemen.

CORDYCEPS IN THE TIBET AR

In Tibet AR *Cordyceps sinensis* in general is distributed in areas with more than 350 mm annual precipitation[18]. In the southern Counties of Nagchu Prefecture, such as Diru (Biru) and Bachen, where some of the best fieldwork so far published on *Cordyceps sinensis* and its host insects (Chen *et al.*, 2000, 2002) has been carried out. South Nagchu is known for its large yartsa specimens. In Biru County yartsa collection has heavily impacted the local economy according to Ben Jiao (pers. com., 2004); now many locals earn enough money through yartsa collection that they can afford to hire Tibetans from poor areas in Shigatse Prefecture to carry out their agricultural work. During collection season tent cities develop in the grasslands complete with bars, brothels and shops. The County government tries to keep outside pickers away by charging high collection fees; also, there is a tax on trade of *Cordyceps sinensis* in Biru. Yartsa riches have been spent on new houses and trucks. Also Nyingchi County (Pinyin: Linzhi, Nyingchi Prefecture) blocked access for outsiders in 2003 and started to sell licenses only to locals. However, some locals figured out that selling their licenses to outsiders for good money is easier than collecting themselves. Licenses were partially introduced, since the previous harvest was much lower than previous years. This was attributed to over-collection according to Luorong Zhandui (com., 2004).

CORDYCEPS IN THE HIMALAYAS

In recent years the *Cordyceps* collection – Zang & Kinjo (1998) recognize the caterpillar fungus from Nepal as a distinct species, *C. nepalensis* – has increased dramatically in the Himalayan region. Most of the product is destined for export to Tibet AR. While Shresta *et al.* (1998) reported from Dolpo, Nepal, that locals receive below 15% of the price on the Chinese market, prices now have sharply risen in Nepal and also in India and Bhutan in the last years. In Bhutan, collection of *Cordyceps* is illegal in order to give them full protection. However, Turkelboom *et al.* (2001) rightly remark that outlawing harvesting of very valuable species without proper monitoring leads to poaching and all sustainability issues will be disregarded.

Similarly, in Nepal yarsagumba is under legal protection and has been banned from export without a government permit since 1996. In 2001 it was opened for trading with the royalty of NR 500 (US$ 6.60) per piece, an irrational fee, which surely will encourage smuggling (Das, 2001). It is interesting to note that in connection with the insurgency in Nepal, where government control has ceased in many alpine areas, the insurgents have established a more realistic and thus more profitable taxation. Marietta Kind (pers. com., 2004) reports that the insurgents "control all the Yarsagumba business in Dolpo now." They collect "revolution tax" on each kilogram (5,000 NR) traded, combined with a tax per picker (500 NR) and a tax per trader (20,000 NR). They also encourage collectors from other regions of Nepal to join the picking to optimize their "tax base". So in 2003 the area with its formerly hidden valleys was crowded with thousands of pickers digging holes everywhere, using up scarce firewood and leaving behind piles of garbage.

Overall, *Cordyceps* harvest has increased dramatically in Nepal and other Himalayan areas. In addition yarsagumba is also being collected in India's Arunachal Pradesh and Uttaranchal[19], where it has only recently come to the attention of researchers (Garbyal, 2001; Arif & Kumar, 2003), while its occurrence in the high altitude areas of Sikkim has been known for long time.

[17] In May 2004 the prize for the biggest specimen peaked at ¥10 (pers. com. A. M. Fischer).
[18] The Atlas of Tibet AR (1996) reports *Cordyceps sinensis* in 47 of TAR's 75 Counties. Only 2 Counties with less than 300 mm/a are reported to have *Cordyceps*, while in 8 Counties with precipitation over 310 mm/a *Cordyceps* is not listed as a source of income.
[19] Uttaranchal is the Himalayan region to the west of Nepal and the east of Himachal Pradesh. It used to be administrated as part of Uttar Pradesh and became its own state in 2000.

SUSTAINABILITY

It is known that yartsa has been collected for centuries; some sources indicate harvest rates totaling at least 100 million specimens per year since the 1950s. As reported, collectors in Lithang and other production areas did not mention reduced fruiting, but acknowledged the fact that there are more and more collectors each year. Dealers did not report a reduction in harvest quantities either. In short, no widespread disappearance of *Cordyceps sinensis* has been reported from the Tibetan Plateau. However, it was reported to have historically disappeared from Xishan near Kunming (CAC, 1990: 185), but this could have been caused by a variety of reasons, such as local climate change or any other cause impacting the host moths or the fungus; in addition Xishan is a relatively small disjunct mountain area.

Still, in recent years the issue of the sustainability of current harvest rates has been raised frequently (i.e. He & Sheng, 1995; Bhattarai, 1995; Shei *et al.*, 2001; Zhang *et al.*, 2001). An assessment regarding sustainability of current harvesting levels of *Cordyceps sinensis* is not possible based on the research currently available in the West. Accurate baseline data is missing (as with most mushrooms collected from the wild). In addition, annual fluctuations are very common as with all mushroom fruiting, thus further complicating the interpretation of available data. However, a clear trend toward increased harvesting pressure is recognizable over its entire distribution, which is further accelerating with increasing prices[20].

Pastoralists in many areas of the plateau complain about the destruction of their grasslands by diggers of *Cordyceps* (and other medicinal plants), who make unnecessarily big holes in the turf by using relatively big hoes and by not closing the hole after removal of the fungus. Such careless extraction, often attributed to outsiders poaching yartsa gunbu, not only impacts pasture quality, but also disturbs the habitat of the *Thitarodes* (*Hepialus*) moths, thus potentially undermining sustainability. In this context, the hotly debated issue of overgrazing and grassland degradation also needs to be considered. Although there is no data available on the impact of grassland degradation through overgrazing or desiccation and the abundance of *Thitarodes* (*Hepialus*), it can be speculated that a healthy grassland environment is favorable to larval development. Also, no informant reported on more abundant fruiting of the fungus in degraded areas[21].

The long-term impact of intensive collection on caterpillar fungus and its reproduction is still unknown. Although there are a variety of entomophagous fungi[22], *Cordyceps sinensis* being economically by far the most important, not much research was carried out on these organisms and to my knowledge no research on the long-term impact of recent intense harvesting has yet been published. From a mycological point of view, it can be speculated that, if the fungus is collected after it had time to release enough of its spores, there might be no negative impact at all. To the contrary, handling the fungus might even result in wider "spore" dispersal. As described above *Cordyceps* has developed the rare capacity to divide each spore into 50-100 propagules producing 32 million part-spores to increase its chances of finding its host organism. However, this astounding capacity is of no help if the fungus is removed before "spores" are released. This is the case with *Cordyceps* gathered early in the season. In late April 2004, at the onset of the collection season, none of the specimen offered for sale in Kangding showed signs of maturity of the asci, the spore producing organs (see Fig. 3). Collection of these specimens will negatively impact reproduction. Also Boesi (2003) observed in Lithang, that most of the fungi were collected "before its spores have been abundantly spread by the wind". It is evident that more research is crucial to assess the question of sufficient "spore" dispersal in order to secure sustainability. Also Boesi points out that a reduction of *Cordyceps* might seriously impact the ecological balance of the grasslands, since *Thitarodes (Hepialus)* larvae feed on roots of the forage species.

Outreach programs and public education campaigns need to be initiated to ensure that fungi are harvested only after sufficient spore dispersal has occurred. A simple measure facilitating post-collection spore dispersal could be the introduction of collection containers that allow spores to disperse, such as baskets or netted bags. Hopefully the question of sustainability will be answered in time before *Cordyceps sinensis* populations actually dwindle, an assumption that is not far fetched looking at the track record of *Homo sapiens* unwisely exploiting natural resources. Everything possible needs to be done to ensure that a healthy environment is sustained and sustainable harvesting carried out, so that medicinal fungi and plants will be able to provide a basic income to rural households and healing for generations to come.

[20] In Kangding in April 2004 specimens were offered for 10 RMB per piece. This was also reported from Zhiduo and Jyekundo / Yushu Town, Yushu TAP, Qinghai (pers. com. Harris, June 2004). A.M. Fisher observed big specimens being offered for 15 RMB in Golok in May 2004.

[21] Such a connection might seem far-fetched, however pika (*Ochotona* spp.), a grassland rodent, tends to benefit from overgrazing and is more abundant in degraded grasslands.

[22] Fungi specialized in digesting insects.

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